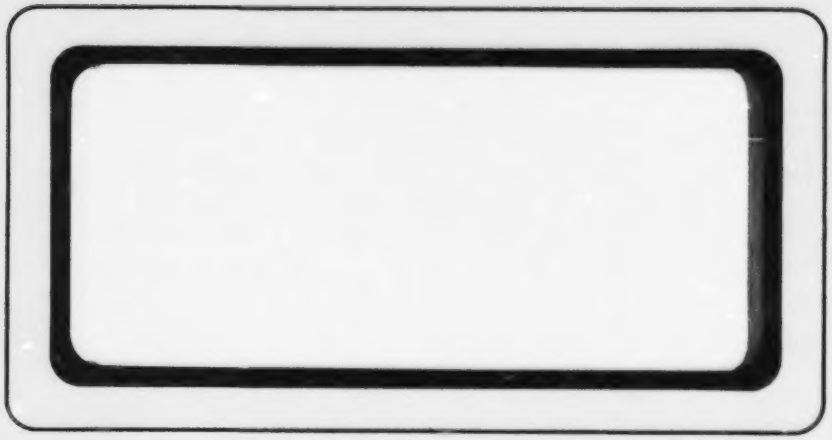

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FLUORIDE IN AMBIENT AIR, VEGETATION, AND WILDLIFE NEAR AN ALUMINUM SMELTER IN KITIMAT, B.C. 1977 - 1986

by
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January 1987

Environmental Section Report 87-02

Canadian Cataloguing in Publication Data

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Fluoride in ambient air, vegetation and wildlife near an aluminum smelter in Kitimat, B.C., 1977-1986

(Environmental Section report, ISSN 0843-4778 ; 87-02)

Bibliography: p.
ISBN 0-7726-0908-X

1. Fluorides - Environmental aspects - British Columbia. I. British Columbia. Waste Management Branch. Environmental Section. II. Title. III. Series.

TD887.F63R45 1989 363.7'387 C89-092042-7

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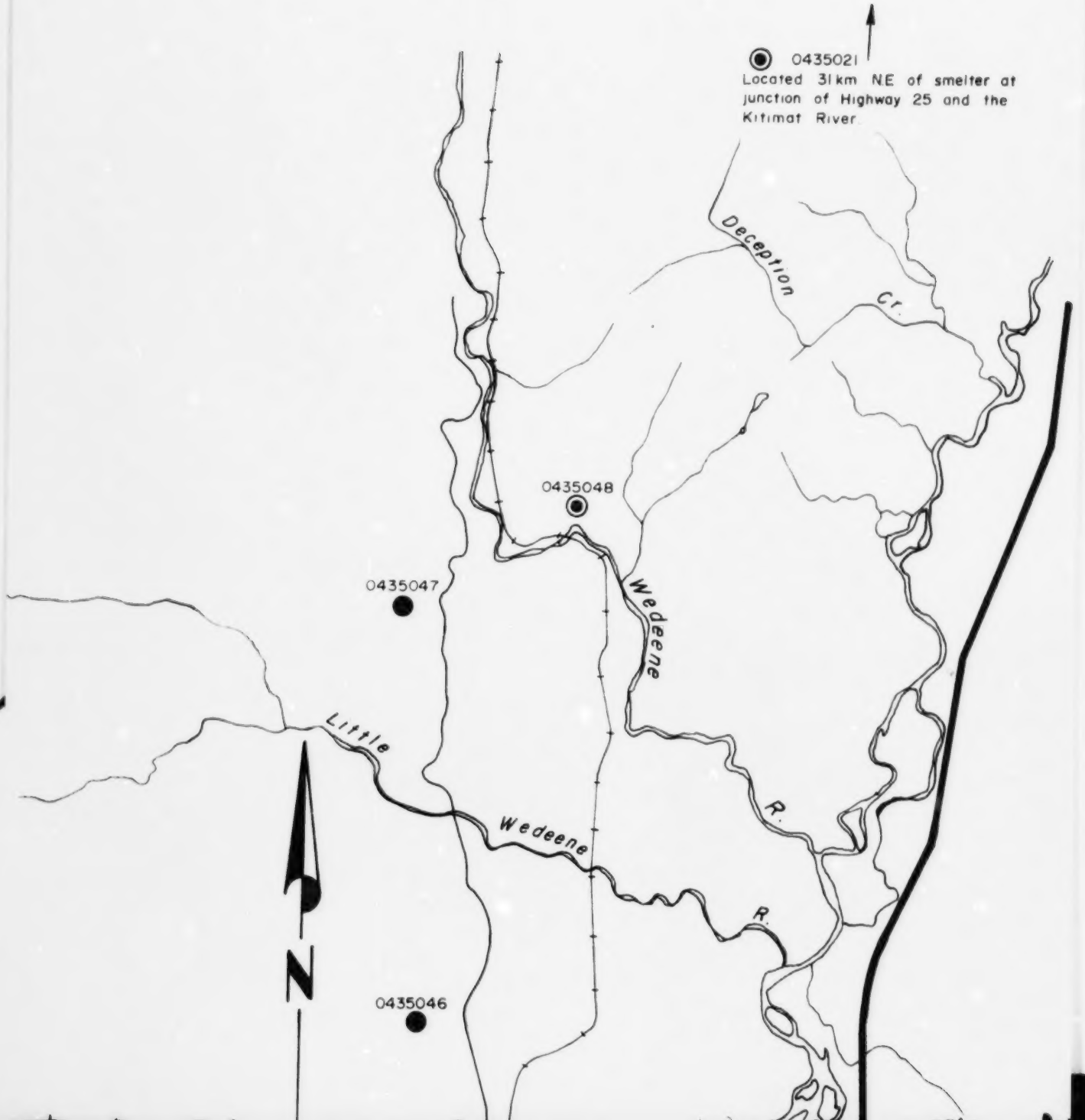
1. INTRODUCTION

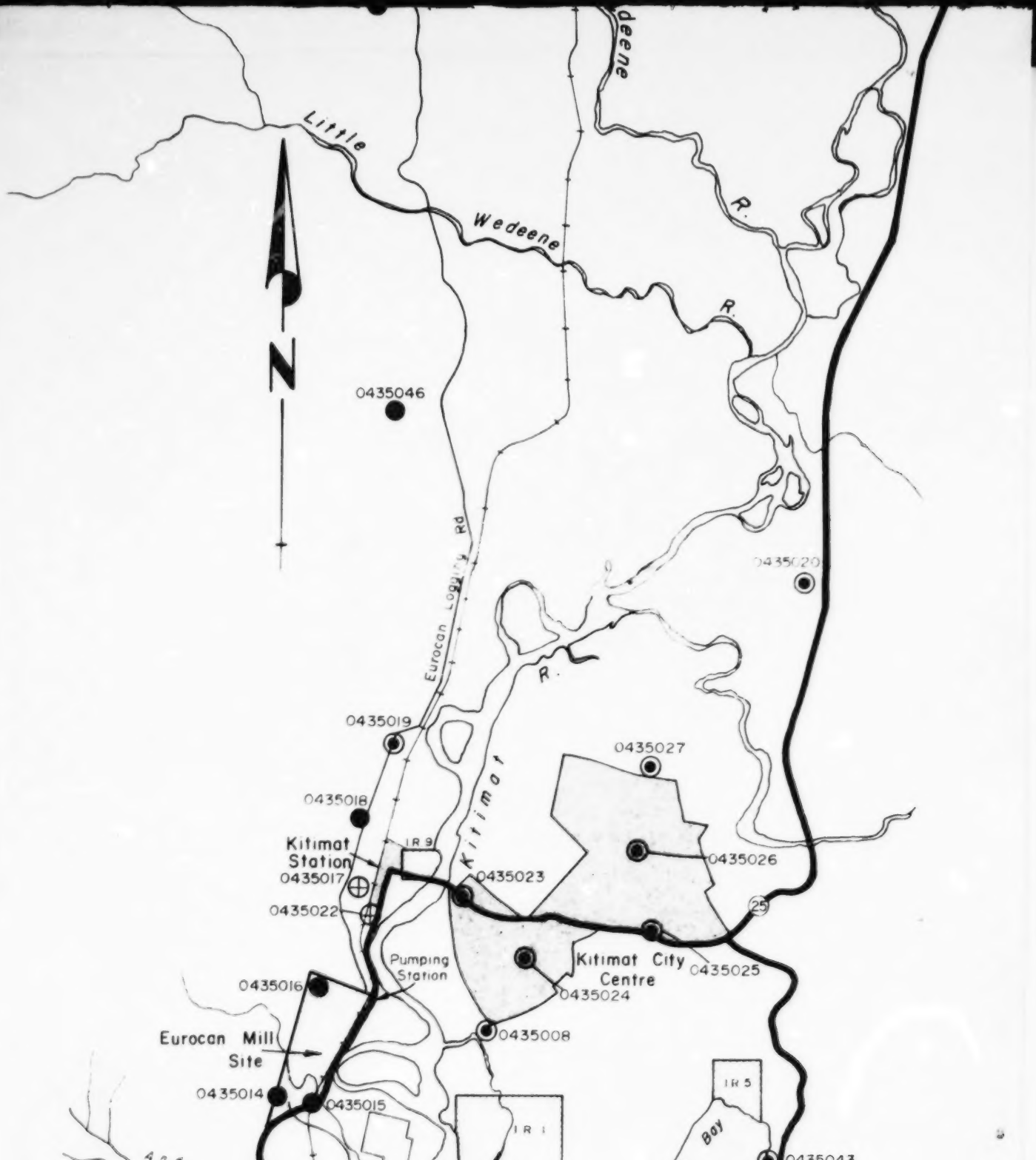
Fluoridation and sulfation plates were operated at various sites throughout the Kitimat Valley, 1976 to 1985 in an attempt to evaluate ambient levels of fluoride and sulfur dioxide emissions from the Alcan aluminum smelter. The fluoridation plate sites are shown in Fig. 1. This report is an analysis of the plate data with recommendations for the on-going ambient air monitoring program. A considerable amount of research has been conducted on the effects of the emissions on the forest and wildlife of the Kitimat Valley. The second part of this report attempts to summarize this research and to suggest avenues for further work.

Although both particulate and gaseous fluoride compounds are emitted from the smelter, mainly gaseous fluorides are considered here, since particulate fluorides have been found to be relatively non-toxic to plants.

The Alcan Kitimat smelter produces approximately 270 000 tonnes of aluminum annually and is among the largest aluminum producing facilities in the world. Associated with the molten fluoride salt requirement for alumina electrolysis in this facility is a gaseous fluoride (hydrogen fluoride) discharge. The hydrogen fluoride (HF) emissions have been reported by Alcan as follows:

Period	F(gas) emitted from plant (tonnes/day)
1955-1959	4.5
1960-1964	5.2
1965-1969	6.0
1971-1974	5.5
1975-1977	3.2
1978-1979	2.3
1980-1986	1.5


0435021
Located 31 km NE of smelter at junction of Highway 25 and the Kitimat River
Deception Cr.
0435048
0435047
Wedeene R.
Little Wedeene R.
N
0435046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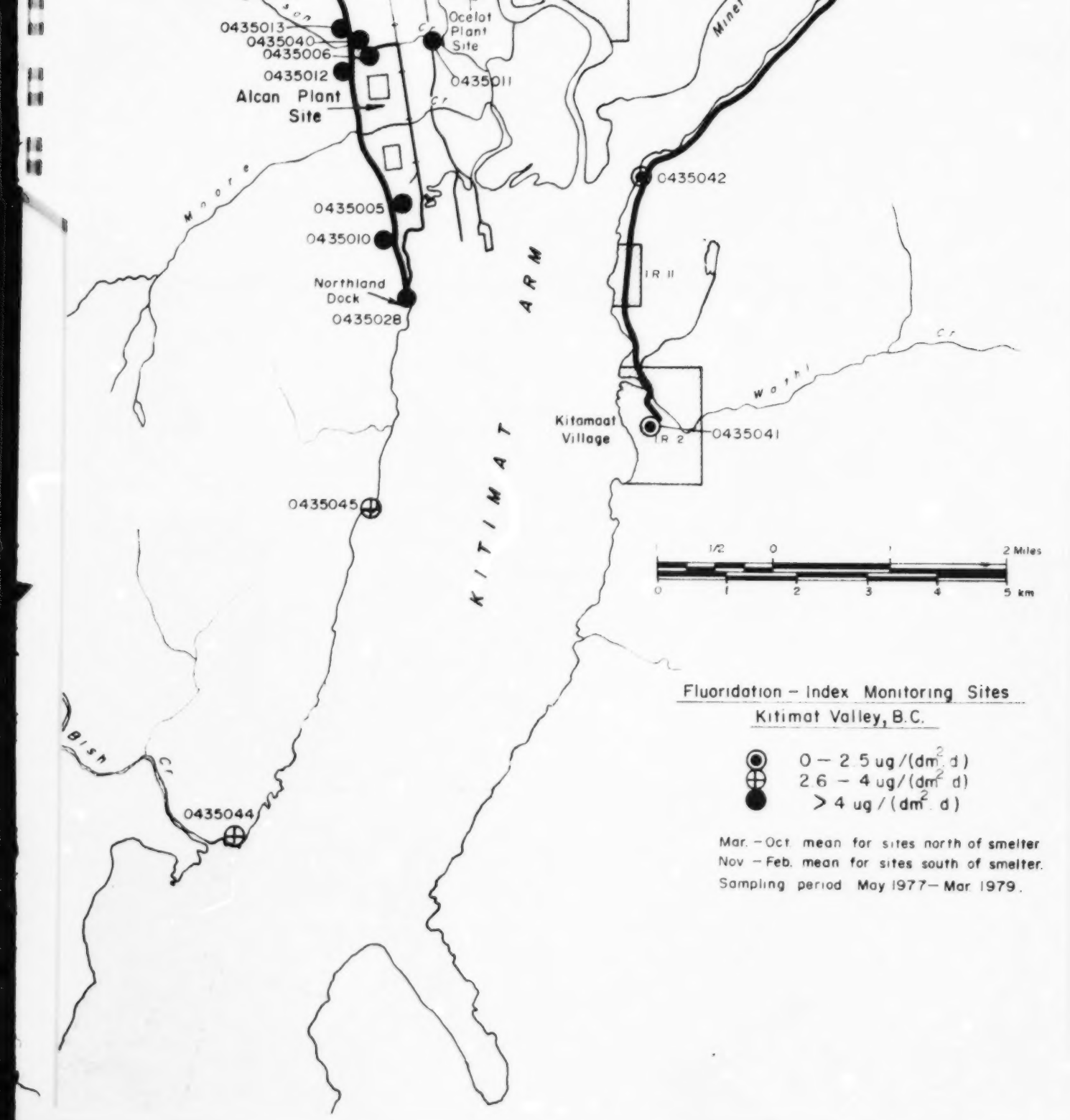
Eurocan Log Dump Rd
0435020
R.
Kitimat
0435019
0435027
0435018
Kitimat Station
0435017
IR 9
0435026
0435023
0435022
25
Pumping Station
Kitimat City Centre
0435025
0435024
0435016
0435008
Eurocan Mill Site
0435014
0435015
IR 1
IR 5
Bay
0435043



Fluoridation – Index Monitoring Sites

Kitimat Valley, B.C.

- 0 – 2.5 ug/(dm^2 d)
- 2.6 – 4 ug/(dm^2 d)
- > 4 ug/(dm^2 d)

Mar. – Oct. mean for sites north of smelter.
Nov – Feb. mean for sites south of smelter.
Sampling period May 1977 – Mar. 1979.

Previous to 1975 there were no actual measurements available, but some estimates based on the number of pots operating and an estimate of the efficiency of operation were compiled for the Alcan Brief to the Public Inquiry into the Pollution Control Objectives of the Mining, Mine-Milling and Smelting Industries of B.C. (Wallace, 1978). Since 1975 emissions from the roof vents and dry scrubbers have been measured by Alcan.

Since 1980, the smelter has emitted about 540 tonnes per year of gaseous fluoride (largely through the pot room roof vents) regulated under air Permit PA-2552. The gaseous fluoride emissions (as kg/tonne of aluminum) from 1974 to present are shown in Figure 2. (Note that the fluoridation index data considered in this report was collected during a period of declining emissions.)

In addition, sulfur dioxide (SO_2) is emitted from the dry scrubbers and pot room vents. The amount is determined by the sulfur content of the raw coke. Emissions prior to 1976 were approximately 15 tonnes/d, and were approximately 22 tonnes/d in 1979 (Alcan Surveillance Committee, 1979). In 1982 Kotturi reported that emissions had been reduced to 13.1 tonnes/d. Recent SO_2 emissions as reported by Alcan are as follows:

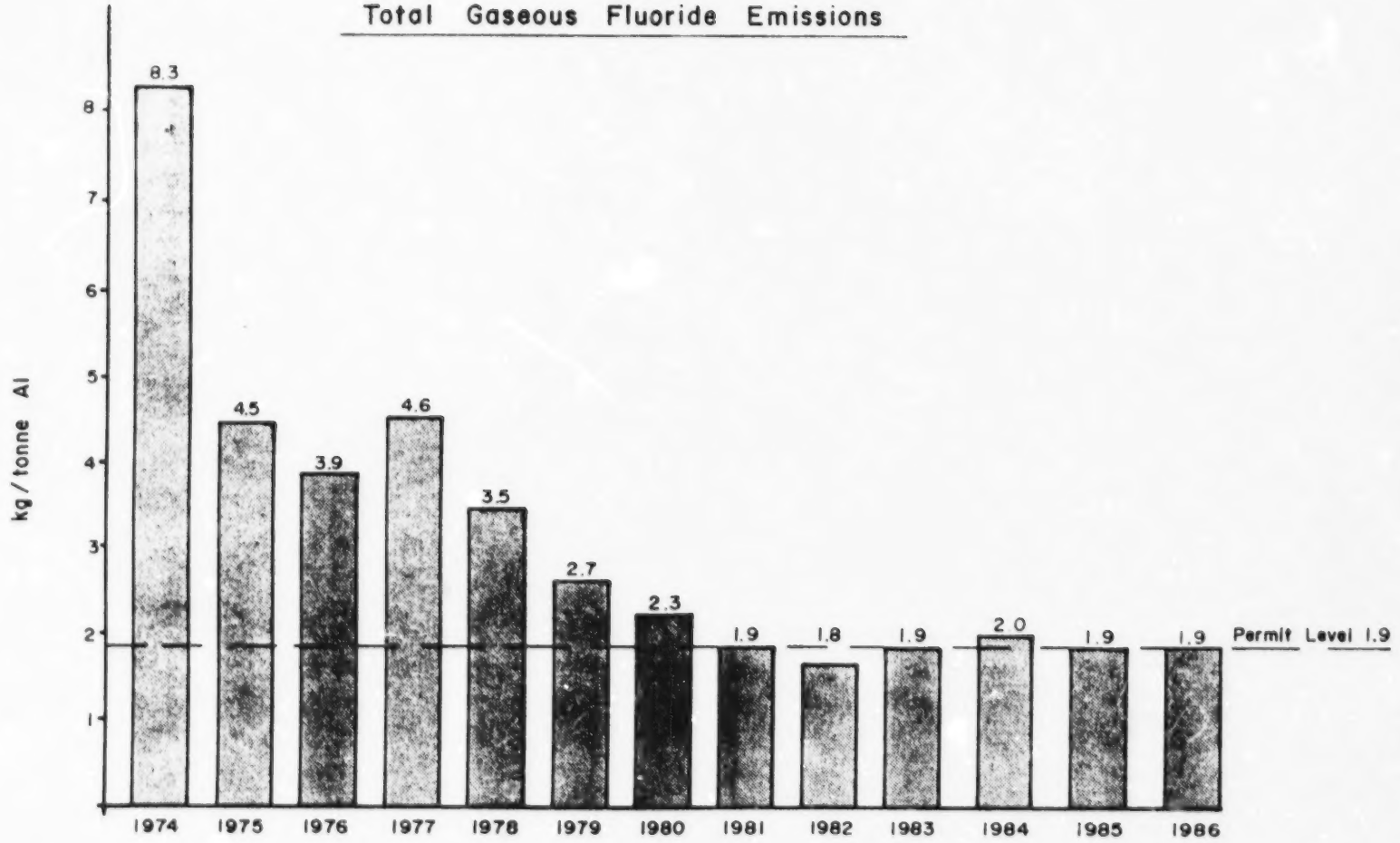
	Estimated SO_2 tonnes/day
1983	13.6
1984	15.6
1985	15.8
1986 (missing last 3 months)	18.0

In addition there is less than .5 kg/tonne or less than 370 kg/d of chlorine gas or chlorine/nitrogen gas mixtures emitted along with various hydrocarbons, particulate fluoride and particulate aluminum oxide.

The Eurocan Pulp and Paper Ltd. mill, located 3.5 km north of the Alcan smelter has emissions of 1.2 to 2.0 tonnes/d of SO_2, less than 1.0 tonne/d of organic sulfur compounds (total reduced sulfur) and 10 tonnes/d of particulate matter (Kotturi, 1982).

Fig. 2

Total Gaseous Fluoride Emissions



2. METHODS

Monitoring Sites

From 1976 to early 1979, there were altogether forty-nine fluoridation plate sites in the Kitimat Valley operated by the B.C. Ministry of Environment Pollution Control Branch (PCB) and by Alcan. Alcan also operated sulfation plates at some of the sites. In early 1979, PCB terminated all but two F plate sites; one at the smelter north fence, and one at the smelter south parking lot. The monitoring by Alcan was terminated at the end of 1979. Data from both sources was stored on the M.O.E. Equis data bank.

The Alcan F plate data was consistently higher than the PCB data, even at mutual sites. Discussion with Alcan personnel concerning methodology revealed that the Alcan plates had been prepared and analysed within the smelter and were contaminated by the high in-smelter HF levels (Alcan Environmental Dept., M. Hellenius, pers. comm.). The sulfation plates were similarly contaminated. Therefore, only the PCB F plate data is considered in this discussion. The thirty-one PCB monitoring sites are shown in Figure 1. The Fluoridation Index (F Index) at these sites for the period of May 1977 to March 1979 is included in Appendix 1. (This is the time period in which there was comparable data from all the sites, and encompasses most of the available data.) The F Index data for the two ongoing sites immediately north and south of the smelter is also in Appendix 1. Because the Alcan F Index data was excluded, the concentrations shown in this report differ somewhat from those previously reported by Manna, 1979, Manna and Morandini, 1979, and Kotturi, 1982.

Fluoridation Index

The B.C. Ministry of Environment Laboratory developed the calcium oxide plate method for the determination of Fluoridation Index (in ug/dm^2 per day). The calcium oxide plate is exposed for a period of 30 days, during which time the gaseous fluoride is collected. The plates are sealed, then shipped to the MOE laboratory, where the fluoride is extracted and measured using the selective ion electrode procedure. The fluoride concentration in unexposed CaO plates from the same batch is also determined and subtracted from that of the exposed plates (McQuaker, 1983). Lynch et al, 1978, have determined that the calibration factor, which is the ratio of ambient fluoride concentration

a n d Fluoridation Index, is 0.087 ± 0.0162 $(ug/m^3)/d/[ug/(dm^2.d)]$. The wind speed associated with this calibration factor is 4.7 miles/hr. If the mean wind speed during the sampling period is known to be significantly different from this value, then a correction factor of $(V/4.7)^{1/2}$ should be used, where V is the mean wind speed in miles per hour during sampling. The absorption rate of the CaO plate is also dependent on the physical and chemical properties of the fluorides emitted, and on fluctuations in meteorological conditions such as sunlight, temperature and humidity. Lynch et al conclude that these factors may effect the fluoride absorption rate by ± 18.4%. Fluoridation plates are only useful for estimating mean ambient concentrations on a monthly basis, but have the advantage of being relatively inexpensive and maintenance free.

Climate

Atmospheric Environment Service monthly wind data recorded at the Kitimat townsite station (the firehall), elevation 128 m, during the study period is shown in Appendix 2. The A.E.S. summary of wind data for the Kitimat townsite station 1967 - 1980 is in Appendix 2. (Canadian Climate Normals, Vol. 5, Wind, 1982.) The annual wind rose and a figure which presents percentage wind frequencies by direction for each month are also in Appendix 2 (taken from Bell and Kallman, 1976). Winds from the north and south are heavily predominant, accounting together for 70 percent of hourly winds. The strongest winds are from the north, November through February, and are associated with outflowing Arctic air, although strong southerly winds generated by active Pacific storms also occur in the winter. From March through October, the strongest winds are from the south. A second wind station, Kitimat 2, is located at the Alcan smelter site, elevation 17 m. Data was not available during the study period from this station. The station records slightly lower wind speed than the Kitimat Townsite station.

Surface-based inversions are frequent in the Kitimat Valley overnight and early morning in all seasons as well as through the day in spring and summer. In spring and summer, these are due to milder Pacific air overrunning the surface air, which has been cooled by the cold sea surface, and the effect is carried inland by the onshore prevailing wind. In winter they are due to the cold surface layers of outflowing Arctic air in the valley bottom. The seasonal percentage frequency of surface-based inversions at Kitimat in the late

afternoon and early morning as determined by Bell and Kallman, 1976, is as follows:

	winter	spring	summer	fall
P.M.	40	55	50	40
A.M.	65	67	62	57

The temperature and precipitation summary for Kitimat 1967-1980 are included in Appendix 2. The month of October has the most precipitation (361.4 mm) and the greatest number of days with precipitation (22 days). June and July are the driest months (averaging 12 days with precipitation). In general May to July are relatively dry (approximately 60-80 mm rain) and October to February are wet months (approximately 230 to 360 mm). The average frost-free period at Kitimat Townsite (1951-80) is May 6-Oct 19 (5 1/2 months).

In summary, with a high percentage frequency of ground-based inversions and winds which prevail in one direction for extended periods, either up or down the valley, it is expected that local episodes of high pollutant concentration would be expected, particularly in the drier summer months. (However the average 2300 mm of precipitation annually, occurring on 53% of days, would help wash out the pollutants.)

For the purposes of this study November to February is defined as winter (northerly winds predominate) and March to October is defined as summer (southerly winds predominate). Winds from the southeast, south, and southwest are combined and the mean summer wind speed computed, likewise with winter winds from the northeast, north and northwest (Appendix 2). The appropriate mean wind speed was then used to correct the calibration factor, as discussed previously (Lynch et al, 1978). An example of the wind speed correction for the calibration factor is also shown in Appendix 2.

3. RESULTS

The mean March to October F Index and estimated mean ambient fluoride concentration at each site are shown in Tables 1a and 1b. The sites are grouped north and south of the smelter and listed in order of increasing distance from the smelter. The estimated ambient fluoride concentrations were calculated using the calibration factor and wind speed correction in the appropriate direction during sampling. The mean F Index for each site is also indicated in Figure 1 (based on level A and level B criteria). The maximum F Index recorded at each site, estimated ambient concentration, month of occurrence, and percent wind frequency are shown in Tables 2a and 2b. As mentioned previously, gaseous fluoride emissions as monitored by Alcan were decreasing during this time period. A comparison between sites does indicate the location of a distinct plume path.

It is apparent that sites north of the smelter receive maximum fluoride impingement during the summer, when southerly winds predominate. The emissions appear to follow a fairly narrow path directly north from the smelter along the steep valley wall for at least 16 to 18 km (note sites 0435046, 47 and 48). Site 0435019, which is located in the valley bottom 7.4 km north of the smelter shows surprisingly low levels. This may be an elevational effect, indicating that the main fluoride accumulation occurs during ground-based temperature inversions. During an inversion the fluoride would accumulate in a layer above the valley floor. (During windy periods, in contrast, the fluoride would tend to be mixed throughout the air column.)

Monitoring to the south of the smelter was much less extensive due mainly to the lack of road access. The sites immediately south of the smelter had the greatest fluoride accumulation in the winter months, when winter winds predominate, as might be expected. Sites 0435045 and 0435044, 4.5 and 9.2 km south along the west side of Kitimat Arm were only sampled for three months in the summer, but these results indicate that the emissions may travel a considerable distance to the south as well, even in the summer months. The sites on the east side of Kitimat Arm, sites 0435042 and 0435041 showed occasional accumulation, usually in the summer months.

TABLE 1a FLUORIDATION INDEX AND ESTIMATED MEAN AMBIENT FLUORIDE CONCENTRATION NORTH OF SMELTER MAY 1977 - MARCH 1979

Equis Site Number	Description	Distance from Smelter (km)	Direction from Smelter	Mean F Index March - October ug/(dm^2.d)	Estimated Mean Conc. ug/m^3	n	Mean F Index November - February ug/(dm^2.d)	Estimated Mean Conc. ug/m^3	n
0435012	Water Tower	0.5	W	14.3	1.5	13	14.1	1.5	8
0435006	Smelter North Fence	0.5	N	163.1	17.5	14	66.7	7.1	8
0435040	Alcan Tour Building	0.6	NNW	36.0	3.9	14	3.5	0.4	8
0435011	Anderson Creek Bridge	0.8	NNE	13.9	1.5	12	15.5	1.7	8
0435013	Old Trailer Court	0.8	NNW	28.4	3.0	13	3.8	0.4	8
0435014	Hydro Sub-Station	2.1	NNW	5.6	0.6	14	1.3	0.1	8
0435015	C.N. Crossing	2.2	N	18.1	1.9	14	5.6	0.6	8
0435016	Eurocan Burner	3.5	NNW	7.8	0.8	13	1.9	0.2	8
0435008	Pollution Control Ctr	3.7	NNE	1.0	0.1	11	0.7	0.1	8
0435022	Standard Station	4.3	N	3.3	0.4	14	2.2	0.2	8
0435017	Doc's Cartage	4.8	N	5.5	0.6	12	2.8	0.3	7
0435024	Kildala School	4.8	NE	1.2	0.1	13	0.8	0.1	8
0435023	Water Pumphouse	5.1	NNE	1.1	0.1	13	1.1	0.1	8
0435018	Saunder's Workshop	5.6	N	5.1	0.5	12	2.0	0.2	8
0435043	Minette Bay Marina	6.0	NE	0.9	0.1	10	<0.5	<.1	8
0435025	Public Safety Bldg	6.1	NE	0.9	0.1	13	0.6	0.1	5
0435026	Lahakas and Nalabila	6.8	NE	1.0	0.1	14	0.7	0.1	7
0435027	Alexander Elem School	7.3	NE	1.0	0.1	7	0.6	0.1	8
0435020	Cable Car Subdivision	11.0	NE	0.7	0.1	11	0.6	0.1	8
0435019	Mile 3, Eurocan Road	7.4	N	1.4	0.1	10	1.0	0.1	6
0435046	Mile 6, Eurocan Road	11.0	N	6.7	0.7	14	2.1	0.2	7
0435047	Mile 9, Eurocan Road	16.0	N	5.0	0.5	14	2.0	0.2	5
0435048	Iron Mountain	17.6	N	2.0	0.2	11			
0435021	End of Valley	31.0	NE	1.0	0.1	12	1.0	0.1	8

Estimated mean ambient concentrations calculated using calibration factor and mean southerly wind speed during sampling period (Lynch et al, 1978).

Level A Fluoridation Index Criterion = 2.5 ug/(dm^2.d)
Level A Gaseous Fluoride Criterion = 0.35 ug/m^3

TABLE 1b FLUORIDATION INDEX AND ESTIMATED MEAN AMBIENT FLUORIDE CONCENTRATION SOUTH OF SMELTER MAY 1977 - MARCH 1979

Equis Site Number	Description	Distance from Smelter (km)	Direction from Smelter	Mean F Index March - October ug/(dm^2.d)	Estimated Mean Ambient Conc. ug/m^3	n	Mean F Index November - February ug/(dm^2.d)	Estimated Mean Ambient Conc. ug/m^3	n
0435005	S Parking Lot	0.5	S	10.8	1.0	12	49.9	6.6	8
0435010	Northland Dock Road	1.0	S	3.7	0.3	13	31.4	4.2	8
0435028	Northland Dock	1.9	S	4.8	0.5	14	27.1	3.6	8
0435042	Minette Bay (Midway)	3.1	SE	1.6	0.1	15	<0.5	<.1	8
0435041	Kitimat Village	5.0	SE	1.6	0.1	12	0.8	0.1	7
0435045	Kitimat Arm	4.5	S	3.9	0.4	3			
0435044	Bish Creek	9.2	S	3.8	0.4	3			

Estimated mean ambient concentrations calculated using calibration factor and mean southerly wind speed during sampling period (Lynch et al, 1978).

Level A Fluoridation Index Criterion = 2.5 ug/(dm^2.d)
Level A Gaseous Fluoride Criterion = 0.35 ug/m^3

TABLE 2a MAXIMUM FLUORIDATION INDEX AND ESTIMATED AMBIENT FLUORIDE CONCENTRATION NORTH OF SMELTER MAY 1977 - MARCH 1979

Equis Site Number	Description	Distance from Smelter (km)	Direction from Smelter	Maximum F Index ug/(dm^2.d)	Estimated Ambient Conc (30 day) ug/m^3	Date	Wind Frequency (Kitimat Townsite Station)	
0435012	Water Tower	0.5	W	38.1	4.3	Jul 77	S 41%	SW 33%
0435006	Smelter North Fence	0.5	N	296.4	35.0	Jul 78	SW 48%	S 25%
0435040	Alcan Tour Building	0.6	NNW	69.4	7.9	Jul 77	S 41%	SW 33%
0435011	Anderson Creek Bridge	0.8	NNE	46.0	5.4	Dec 78	SE 48%	N 32%
0435013	Old Trailer Court	0.8	NNW	71.0	8.1	Jul 77	S 41%	SW 33%
0435014	Hydro Sub-Station	2.1	NNW	13.1	1.5	Jun 77	S 40%	SW 39%
0435015	C.N. Crossing	2.2	N	35.4	4.0	Jun 77	S 40%	SW 39%
0435016	Eurocan Burner	3.5	NNW	22.8	2.6	Jun 77	S 40%	SW 39%
0435008	Pollution Control Ctr	3.7	NNE	4.9	0.5	Jun 77	S 40%	SW 39%
0435022	Standard Station	4.3	N	8.6	1.0	Jun 77	S 40%	SW 39%
0435017	Doc's Cartage	4.8	N	13	1.5	Jun 77	S 40%	SW 39%
0435024	Kildala School	4.8	NE	3.1	0.3	Jun 77	S 40%	SW 39%
0435023	Water Pumphouse	5.1	NNE	5.2	0.6	Jun 77	S 40%	SW 39%
0435018	Saunder's Workshop	5.6	N	12.3	1.4	Jun 77	S 40%	SW 39%
0435043	Minette Bay Marina	6.0	NE	3.3	0.4	Jun 77	S 40%	SW 39%
0435025	Public Safety Bldg	6.1	NE	2.0	0.2	Jun 77	S 40%	SW 39%
0435026	Lahakas and Nalabila	6.8	NE	2.3	0.3	Jun 77	S 40%	SW 39%
0435027	Alexander Elem School	7.3	NE	2.2	0.2	Jun 77	S 40%	SW 39%
0435020	Cable Car Subdivision	11.0	NE	1.4	0.2	Nov 77	NE 30%	SW 27%
0435019	Mile 3, Eurocan Road	7.4	N	3.8	0.4	Jun 77	S 40%	SW 39%
0435046	Mile 6, Eurocan Road	11.0	N	15.1	1.7	Jun 77	S 40%	SW 39%
0435047	Mile 9, Eurocan Road	16.0	N	12.2	1.4	Jul 77	S 41%	SW 33%
0435048	Iron Mountain	17.6	N	4.8	0.5	Jul 77	S 41%	SW 33%
0435021	End of Valley	31.0	NE	4	0.5	Nov 77	NE 30%	SW 27%

Estimated mean ambient concentrations calculated using calibration factor and mean southerly wind speed during sampling period (Lynch et al, 1978).

Level A Fluoridation Index Criterion = 2.5 ug/(dm^2.d)
Level A Gaseous Fluoride Criterion = 0.35 ug/m^3

TABLE 2b MAXIMUM FLUORIDATION INDEX AND ESTIMATED AMBIENT FLUORIDE CONCENTRATION SOUTH OF SMELTER MAY 1977 - MARCH 1979

Equis Site Number	Description	Distance from Smelter (km)	Direction from Smelter	Maximum F Index ug/dm^2.d)	Estimated Ambient Conc. (30 day) ug/m^3	Date	Wind Direction (Kitimat Townsite Station)	
0435005	S Parking Lot	0.5	S	73.5	9.19	Feb 79*	N 43%	S 23%
0435010	Northland Dock Road	1.0	S	57.9	7.5	Dec 77*	N 41%	NE 17%
0435028	Northland Dock	1.9	S	54.9	8.3	Jan 78	NE 65%	N 21%
0435042	Minette Bay (Midway)	3.1	SE	6.3	0.7	Mar 79*	S 32%	N 30%
0435041	Kitimat Village	5.0	SE	4	0.5	Jun 77	S 40%	SW 39%
						Mar 79*	S 32%	N 30%
0435045	Kitimat Arm	4.5	S	5.9	0.5	Sep 77	NE 27%	SW 24%
0435044	Bish Creek	9.2	S	5.7	0.5	Sep 77	NE 27%	SW 24%

* Average monthly wind data 1967-80.

Estimated mean ambient concentrations calculated using calibration factor and mean northerly wind speed during sampling period (Lynch et al, 1978).

Level A Fluoridation Index Criterion = 2.5 ug/(dm^2.d)
Level A Gaseous Fluoride Criterion = 0.35 ug/m^3

F Index and estimated ambient concentrations at sites 0435005 (South Parking Lot) and 0435006 (Smelter North Fence) are shown in Table 3. These sites are on Alcan property, approximately 0.5 km south and north of the nearest potlines. To the south of the smelter during the summer when the wind is predominantly from the south, the mean F Index is 8.9 ug/(dm^2.d). During the winter months, when northerly outflow winds occur, the mean F Index is 36.7 ug/(dm^2.d). The reverse trend is seen on the north side where during summer the mean F Index is 121.4 ug/(dm^2.d) and 63.9 ug/(dm^2.d) in the winter. The maximum monthly values occur during the growing season to the north of the plant. This seasonal trend has been noted by other researchers (Manna, 1979, Manna and Morandini, 1979, Kotturi, 1982).

The location of the plume path directly north and (less frequently) south of the smelter is confirmed by the fluoride content of hemlock foliage surveys and the Lichen Index of Air Purity surveys which have been carried out by Dr. Bunce (1981 and 1986). This geographic pattern was also shown by Gordon (1976) and Rice (1984) in fluoride and sulfur levels in vegetation. The extensive insect outbreak which killed conifers in a 32 km strip north along the west side of the valley in the 1960-69 period has been linked to the emissions path by numerous researchers (Gordon, 1976, Weinstein, 1977 and reviewed by the Alcan Surveillance Committee, 1979).

An investigation of precipitation chemistry conducted by Kotturi (1982) indicates that emissions travel as far north as the Terrace Airport. The results indicate that fluorides and SO_2 are washed out of the atmosphere by precipitation (i.e. concentrations are lower during high rainfall periods) and that both pollutants increase precipitation acidity. Elevated fluoride deposition was also measured at the Terrace Airport indicating that "the Terrace site is influenced by emissions from Kitimat." The concentration of fluoride in precipitation in Kitimat (0.07 to 2 mg/L) and Terrace (0.04 to 0.16 mg/L) exceeded that measured at Prince Rupert and a control site (L0.04 mg/L.)

TABLE 3

FLUORIDATION INDEX AND ESTIMATED AMBIENT CONCENTRATIONS
IMMEDIATELY NORTH AND SOUTH OF SMELTER 1977-1985

0435005 SOUTH PARKING LOT

	F Index Mean Mar-Oct ug/(dm^2.d)	F Index Mean Nov-Feb ug/(dm^2.d	F Index Annual Mean ug/(dm^2.d)	Estimated Annual Mean Ambient ug/m^3	Maximum F:Index ug/(dm^2.d	Month of Max. Conc.	Estimated Maximum Conc. ug/m^3 (30 day)
1977	10.7	61.7	27.7	3.4	81.2	Dec	9.9
1978	7.4	46.9	23.2	2.8	67.0	Jan	8.1
1979	17.4	32.2	22.3	2.7	73.5	Feb	9.0
1980	8.0	77.6	31.2	3.8	96.7	Feb	11.8
1981	5.8	17.7	9.8	1.2	33.5	Dec	4.1
1982	5.4	20.5	11.5	1.4	29.5	Jan Feb	3.6
1983	8.1	20.9	12.4	1.5	31.4	Jan	3.8
1984	8.9	25.5	14.4	1.8	43.4	Dec	5.3
1985	8.8	27.2	13.8	1.7	66.0	Jan	8.1

0435006 SMELTER NORTH FENCE

	F Index Mean Mar-Oct ug/(dm^2.d)	F Index Mean Nov-Feb ug/(dm^2.d	F Index Annual Mean ug/(dm^2.d)	Estimated Annual Mean Ambient ug/m^3	Maximum F Index ug/(dm^2.d	Month of Max. Conc.	Estimated Maximum Conc. ug/m^3 (30 day)
1977	165.0	55.1	120.0	12.6	229.5	Jun	24.1
1978	166.7	68.4	130.9	13.7	296.4	Jul	31.1
1979	188.0	87.4	154.5	16.2	302.8	May	31.8
1980	112.4	81.6	100.5	10.6	193.0	Jul	20.3
1981	85.5	35.4	68.8	7.2	122.3	Oct	12.8
1982	95.3	17.7	79.8	8.4	138.0	Aug	14.5
1983	89.9	40.7	70.2	7.4	147.0	May	15.4
1984	71.7	93.9	80.6	8.5	165.2	Jun	17.3
1985	118.1	95.0	111.1	11.7	207.4	Feb	21.8

Estimated ambient concentrations calculated using calibration factor and corresponding mean wind speed (AES Climate Normals 1951-1980) according to Lynch, et al, 1978.

Level A Fluoridation Index Criterion = 2.5 ug/(dm^2.d)

Level A Gaseous Fluoride Criterion = 0.35 ug/m^3

Ambient Air Quality Criteria

The recommended Level A and Level B air quality criteria for gaseous fluoride and for Fluoridation Index (30 day averaging period) are as follows:

Criteria	Fluoridation Index $ug/(dm^2.d)$	Gaseous Fluoride ug/m^3
Level B	4.0	0.50
Level A	2.5	0.35

The rationale for this recommendation is to provide adequate protection for the most sensitive vegetation (Air Quality Standards Committee of B.C., 1984, Draft.)

Most sites exceeded the Fluoridation Index criteria at least once during the study period. (The exceptions being at Minette Bay and in the residential areas of Kitimat.) It is interesting to note that concentrations far exceeding the criteria were found 11 km. and 16 km. north of the smelter in June - July, 1977 (15.1 $ug/(dm^2.d)$ at Mile 6, and 12.2 $ug/(dm^2.d)$ at Mile 9, Eurocan Road. The mean F Index during the summer months at these sites were 6.7 $ug/(dm^2.d)$ and 5.0 $ug/(dm^2.d)$ respectively.

The associated ambient gaseous fluoride concentrations have been computed, however it is felt that the error introduced by the wind calibration may be too great to directly compare these figures to the gaseous fluoride criteria. The condition of vegetation in the area at this time was summarized by the Alcan Surveillance Committee (1979) as follows:

"The evidence indicates that smelter emissions have affected vegetation. The two extremes are the residential area where only a very sensitive species, gladiolus, has been affected, and the area within 1 mile immediately to the north of the smelter where relatively severe fluoride effects can be seen. Between a distance of 1 mile and 10 miles north, subtle fluoride injury has been detected and confirmed by fluoride analysis, but the overall picture to the untrained observer is one of profuse and apparently healthy regrowth amongst the insect-killed trees. Levels of fluoride in tree foliage at Kitimat are such that more severe damage would be expected than is presently found, based on experience elsewhere. The lack of wide-spread, visible symptoms may be a consequence of favourable soil and climatic conditions unique to Kitimat."

Monitoring Implications for Fluoride

The fluoridation plate data indicate that the main fluoride impingement occurs north of the smelter, elevated above the valley floor. The Waste Management Branch operates a DKK continuous gaseous fluoride monitor in a trailer which is located at the Minette hydro substation for 6 months in the summer and at Northland Dock south of the smelter for 6 months in the winter. Alcan presently operates three TessCom continuous monitors located (1) in the WMB trailer (2) at the water pumping station on the Kitimat River near Eurocan (3) at the Public Safety Building (City Center). Since the plume path appears to lie directly north of the smelter along the west side of the valley, some of these monitors should be located at the furthest west hydro powered practical sites, such as the Eurocan burner (0435016), Doc's Cartage (0435017), or Saunder's Workshop (0435018). The Kitimat City Center was seldom shown to be within the plume path.

Fluoride plates could also be located along the forested west side of the valley in the apparent plume path (both north and south of the smelter). (After all, the criteria for fluoride were established to protect vegetation which is much more sensitive to fluoride than are humans). It would be of interest to install fluoride plates near the DKK gaseous fluoride monitor to compare monthly readings obtained.

The only serviced site south of the smelter is at the Northland Dock, which is on Alcan property. If data from this site cannot be used for management purposes (because it is company land), it is suggested that fluoridation plate sites be located on the shoreline south of the Alcan boundary.

Monitoring Implications for Sulfur Dioxide

As mentioned in Section 2, discussion with Alcan personnel has revealed that the Alcan solid absorbent plate data 1977-79 is not valid because of contamination within the smelter laboratory. There has been no recent ambient SO_2 monitoring, although Alcan emitted an estimated 18 tonnes/day in 1986, (in addition to 1.2 to 2.0 tonnes/d from Eurocan). Dr. Weinstein, 1985, in his biennial survey of vegetation at Kitimat mentioned severe SO_2 injury of raspberry on the plant site. Gordon, (1976) and Rice, (1984) measured fluoride and sulfur levels in vegetation in the Kitimat Valley. Sulfur levels were found to be significantly elevated as compared to a control site at Kemano, with the highest foliar levels recorded north of the smelter along the primary plume path. Dr. R. Guderian (1977), in an extensive review of phytotoxicity of acidic gases, states that the effects of HF and SO_2 are additive in fumigation experiments with orange varieties. In general, the risk of injury to vegetation is greater when several pollutants occur together. A Teco SO_2 continuous monitor is being installed in the WMB trailer in early 1987 which will measure concentrations in the vicinity of the smelter. Some sort of monitoring of the SO_2 exposure of vegetation in the plume path would be of value as well, especially in view of the possible additive effects of Hf and SO_2. This might best be done by sulfation plates, because foliar analysis for sulfur does not necessarily reflect short-duration fumigation events (Guderian, 1977).

4. Discussion of Previous Research

The two main effects of fluoride pollution which have been demonstrated in other industrial settings are 1. change of species composition and growth of the plant community, and 2. bioaccumulation of fluoride in wildlife.

Fluoride and Vegetation

Changes in plant community structure and growth have been found as the result of fluoride exposure by several authors (Murray, 1982, Perkins et al, 1980). In general these studies showed a gradual demise of the more sensitive plant species. Such a demise of highly sensitive lichen species has been demonstrated by Dr. Bunce. Because lichens are very slow in recolonizing, and fluoride emissions decreased in the late 70's, this study has not been maintained.

Dr. Bunce of Reid, Collins and Assoc. has made a good effort at assessing the long-term effects of fluoride emissions on the growth of the coniferous forest in the Kitimat Valley (1981, 1984, 1986). Bunce has measured the growth reduction in the plume path, measured fluoride content of western hemlock foliage, and assessed regeneration. He found the degree of growth reduction and the area affected decreased as a response to the decrease in smelter emissions which occurred from 1974 - 79. The rate of wood loss 1954 - 1973 was 2800 m^3/yr & area affected was 7000 ha. The rate of loss 1974 - 1978 was 920 m^3/yr & the area affected shrank to 1400 ha. The rate of wood loss 1979 - 1983 was 760 m^3/yr and area affected was 1200 ha. Fluoride in hemlock foliage decreased from 53 ppm, 1974 - 1978 to 22 ppm, 1979 - 1983. He found regeneration to be reduced but satisfactory.

The control sites located southeast of Lakelse Lake used in this work are somewhat questionable however. It was noted in the Alcan Surveillance Report (1977) that a baseline level prior to smelter start-up of 2.1 ppm was established based on 56 samples. By 1974, the fluoride level in the control plots had risen to approximately 20 ppm, "demonstrating that these areas were not entirely out of the influence of the smelter fumes". Rice (1984) found background levels for western hemlock of 0.5 to 2.2 ppm in 1st and 2nd year needles at a Kemano control site. The Reid Collins control plots averaged 8

ppm in 1979, decreasing to 3 ppm in 1983. The 1979 remeasurement showed a discontinuous pattern of fluoride distribution, with an area of high levels southwest of Lakelse Lake and 30-32 km north of the smelter and only 6 to 8 km west of the "control" sites. A fluoridation plate (0435021) which was located at the Hwy 25 bridge south of Lakelse Lake and adjacent to one of the control sites showed intermittent fluoride accumulation (F Index of 4.0 ug/(dm^2.d) Nov., 1977 and 3.0 ug/(dm^2.d) in May, 1977). In studies of the effects of air pollutants on forest growth and productivity, it is essential to have control sites which are completely free of the pollutant, but otherwise as identical as possible, especially in climate.

It is puzzling why the area southwest of Lakelse Lake was not remeasured in 1984, since a discontinuous pocket of elevated hemlock fluoride levels (70 ppm) were found there in 1979. The area on the southeast side of Kitimat Arm has similarly not been measured, although there is a significant wind component from the north in the winter. (Foliar fluoride accumulation would be expected to be lower in the winter months, however, because of lower temperatures and higher precipitation.)

In general deciduous species accumulate fluoride more rapidly than conifers. These "accumulations" can then pass on high fluoride levels to the wildlife that feeds on them. Palmer (1973) found the fluoride accumulation in deciduous species near Kitimat to be 2 to 2.5 times greater than first year hemlock needles, and the accumulation in grass and wood fern to be similar to hemlock. Rice (1983) analysed hemlock and several deciduous species at 11 sites in the Kitimat to Terrace area. (Rice's hemlock results are in agreement with those reported by Dr. Bunce when compared by year and location.) The fluoride accumulation in alder ranged from 1.2 to 38 ppm, willow ranged from 1.3 to 139 ppm, Huckleberry ranged from 6.3 to 226 ppm, and fireweed ranged from 3.2 to 208 ppm (with the highest concentrations occurring near the smelter on the west side of the valley). The average accumulation in willow, huckleberry, and fireweed was 3 to 4 times that in hemlock.

Kay, et al (1975) found the accumulation of fluoride in stems of cherry and red osier dogwood to be similar to that in the leaves. (Red osier dogwood and willow are important winter browse for moose).

The recommended Level A criteria is 30 ppm and Level B is 40 ppm for fluoride in forage crops (running average of 6 months). These criteria were established to protect dairy cattle. Rice's data for 1983 indicate that willow, huckleberry, and fireweed fluoride levels exceeded the Level B criteria for a distance of 30 km north of the smelter on the west side of the valley. Research on white-tailed deer suggests that criteria to protect wildlife would have to be more stringent than that to protect dairy cattle (Suttie et al, 1985). Criteria have not yet been established for the protection of wildlife in B.C. This is an area requiring further research.

It would be valuable to know what the current fluoride loading in deciduous species is, particularly those which are important to wildlife. Stem collections (in addition to leaf) should be made for important winter browse species (separating first and second year growth). Collections should be made on the west side of the valley and controls selected from a distant location. Collections should be made in the fall, just prior to leaf fall. Western hemlock should be collected at each site whenever possible (separating first and second year growth also). Once correlations are established, one or two species could be selected for monitoring purposes and objectives established for protection of wildlife.

Fluoride and Forest Litter and Soil

Gaseous fluoride is absorbed directly by vegetation and by the forest leaf-litter. Rainfall is very effective in washing fluoride from the atmosphere (increasing the acidity of the rain, Kotturi, 1982). Rainfall also leaches fluoride from vegetation, washing it into the leaf litter. Leaf-fall and needle-fall further contribute fluoride to the leaf litter. Eventually the fluoride reaches the soil surface where mineralization generally occurs. Most soils are regarded as efficient sinks for fluoride. The leaf litter has a critical role in ecosystem function and soil organisms (detrivores) play an important role in efficient nutrient cycling. It has been suggested that fluoride accumulation in surface horizons may interfere with litter breakdown. A study of a wetland ecosystem around a fluoride source demonstrated high fluoride concentrations in soil isopods and arthropods important

in the detritus cycle, although no data were collected on the effects of these accumulations (Murray, 1982). The accumulated fluoride in the forest litter and top soil can be released suddenly by wildfire. Murray estimated that 68% of the fluoride accumulated in the litter in a polluted ecosystem was exported during a wildfire. And a large portion of the soluble fluoride which was retained in the ash was leached out within 8 months.

An estimated 40 000 tonnes of HF have been emitted by the Alcan smelter since 1955. The fluoride concentration in surface litter, soil, and mosses from five sites in the Kitimat Valley in 1976 was determined by Hocking et al (1980). Most of the fluoride appeared to remain in the surface litter and surface soil horizons though there was also evidence of significant penetration to the underlying base layers. The mean fluoride concentration at the four sites within about 3.2 km of the smelter was 608 ug/g in the litter, 499 ug/g in the surface organic layer, 512 ug/g in the A horizon, decreasing to 174 ug/g in the B horizon. A site on the east side of the valley (Hwy 25 Hirsh Creek Bridge) had 88 ug/g in the litter, 138 ug/g in the surface organic layer, and 224 ug/g in the A horizon. The fluoride concentration in moss samples at the sites near the smelter averaged 768 ug/g (maximum 1022 ug/g), compared to 101 ug/g at the Hirsh Creek site.

Fluoride and Wildlife

One of the most notable characteristics of fluoride is its tendency to accumulate through the food chain. The accumulation of skeletal fluoride in herbivorous mammals near fluoride sources has been well documented (Kay, 1974; Newman and Markey, 1976; Yates and Mercer, 1977; Newman and Murphy, 1979, Suttie, et al 1985). Shupe et al, 1972, list the following as the important signs of chronic fluoride toxicity: (1) dental fluorosis (tooth lesions and abnormal wear); (2) osteofluorosis (bone lesions and enlargement); (3) intermittent lameness and stiffness. Messer et al, 1973, demonstrated in laboratory mice that low levels of fluoride in the diet were essential to fertility, but that toxicity developed with high dietary levels evidenced by retarded growth and impaired reproduction.

Dr. Bunce of Reid, Collins collected information on fluoride accumulation in the femurs of small mammals in the Kitimat area from 1974 to 1982. Although it is difficult to generalize from the small sample size, he has found the levels to have decreased since 1976 when the mean level one mile from the smelter was 7 700 ppm in deer mice, 8 910 ppm in vagrant shrews (with no voles caught). In 1979 redback voles 1 mile from the smelter had an average level of 5 165 ppm. (I believe these are the highest levels on record for these small mammals.) Levels had decreased by 1982 and are summarized in the following table.

Mammal Skeletal Fluoride Levels 1982

Mammal	Distance from Smelter (miles)	Mean Fluoride (ppm dry wt.)	Sample Size
Deer Mouse (Peromyscus maniculatus)	1	2 945	14
	10	319	3
	15	538	5
	20	485	1
Vagrant Shrew (Sorex vagrans)	1	5 193	3
	10	--	--
	15	678	1
Redback Vole (Clethrionomys gapperi)	1	--	--
	10	1 279	4
	15	815	1
	20	412	1

Newman and Markey (1976) investigated the effects of elevated fluoride levels in the diet of captured deer mice, finding that mortality and weight loss were proportional to the amount of ingested fluoride. At dietary levels above 1300 ppm, deer mice exhibited marked weight loss, mortality (LD_{50} of 53 days) enlargement of femur diameter, and dental disfigurement resulting in impaired feeding behavior. (The mean concentration of fluoride in the femurs of mice exhibiting these symptoms was approximately 3100 ppm.) Yates and Mercer (1977) found that showshoe hares which had ingested excessive amounts of fluoride during the formulation of permanent dentition had a variety of dental lesions causing excess wear and attrition of teeth as well as heavier bones with a chalky white and irregular periosteal surface (the associated fluoride concentrations in these animals ranged from 3300 ppm to 8500 ppm).

The fluoride levels found in deer mice near the smelter in 1982 are similar to those associated with marked symptoms of fluorosis (in deer mice in a laboratory setting). The insectivorous shrews appear to have accumulated considerably more fluoride than the herbivorous deer mice. This may be an example of bio-magnification. Fluoride accumulation in the forest litter near the smelter has been demonstrated (Hocking et al, 1980). It would not be surprising to find elevated fluoride levels in the detrivores in the litter which are part of the shrews diet. The lack of redback voles near the smelter might indicate this species has less tolerance to fluoride. However, the sample size is very small. Bunce's work on small mammals really just indicates a need for further study.

Since the life expectancy of these small mammals is less than one year and their home ranges are small, they are considered to be valuable indicators of one growing seasons fluoride accumulation (Kay, 1974). Since the main fluoride accumulation in foliage is known to occur on the west side of the valley, sampling should be done in that area (Bunce sampled along the east side). Control levels found by Bunce, 1981, at and beyond 40 miles north of the smelter, were deer mice 330ppm, voles 240ppm, and shrews 1840ppm. These are somewhat higher than those found in unpolluted areas of Montana of deer mice 143.8ppm, meadow vole 136.6ppm, and shrews 493.8ppm (Kay, 1974). A control site which is clearly out of the influence of the smelter such as another coastal inlet, would clarify the control levels.

Skeletal samples of marten, beaver, red fox and moose collected by Fish and Wildlife in 1978 were analysed for fluoride levels. The results are shown below:

Location	Distance from Smelter (km)	Direction from Smelter	Species and Bone	F conc. ppm dry wt.
1 km N of Eurocan west of river	4	N	marten* femur	8 190
"	"	"	mandible of above	7 665
Humphrey's Cr	22	NE	beaver femur	540
Upper Wedeene R	±25	NNW	marten femur	2 345
Upper Wedeene R	±25	NNW	fox femur	850
Lakelse Park	45	N	moose femur	830
Terrace	60	N	beaver femur	2 570
Maroon Cr	±85	N	marten femur	2 385

*This animal had poor teeth.

Subsequently the femurs of an additional 70 animals trapped in 1978-79 were analysed by the Ministry of Environment (Henigman, 1981). The carnivores analysed were 14 marten, 9 weasel, 3 otter, 3 red fox, and 1 mink. Herbivores analysed were 5 beaver, one red squirrel, 2 moose and 2 grouse.

The highest fluoride levels (in all species) were found between 8 and 16 km north of the smelter on the west side of the valley (mean 2301 ppm) with a maximum of 3760 ppm in marten. The level dropped between 15 and 24 km north to 1028 ppm mean (2010 ppm max) and between 24 and 32 km north to 774 ppm mean (1350 ppm max). Within a zone to 8 km north of the smelter, the mean level was 1276 ppm (2750 ppm max), and both the east and west side of the valley were affected. The mean level of the 10 control animals collected distant from the smelter was 594 ppm (1420 ppm max).

There has been speculation on the possibility of bio-magnification of fluoride in carnivorous species (due to the consumption of prey skeletons) and several authors have stated that fluoride accumulation in carnivores should be a priority area of research (Kay et al, 1975; Groth, 1975; Rose and Marier, 1977). In the Kitimat study the carnivorous species had higher mean skeletal fluoride levels; marten 1488 ppm, weasel 1314 ppm, mink 2610 ppm, and red fox 1037 ppm. Fluoride levels in Mustelid species from uncontaminated areas of Montana averaged 380 ppm. River otter, which eat primarily fish, had the lowest mean level, 477 ppm. The herbivorous beaver had a mean level of 860 ppm and the one moose had a level of 1830 ppm.

There is little research into safe fluoride accumulation in wildlife, especially carnivores. Kay et al (1975) found that mule and white-tail deer in Montana exhibited abnormal dental wear and other signs of fluorosis with mandibular fluoride levels of 3 000 ppm. They also observed a change in the age distribution of the population. Newman and Murphy (1979) found signs of fluorosis in black-tailed deer with levels over 2 000 ppm in the metatarsus. Rose and Marier (1977), in a report on environmental fluoride for the National Research Council, stated that the level of 5 000 ppm considered safe for dairy cattle is too high for wildlife. Unlike livestock, a wild animal suffering from impaired feeding ability, weight loss, and lameness would quickly be eliminated from the population by predation or starvation. Some of the bone fluoride levels found in the Alcan plume path in 1978-79 would be cause for concern in light of this research.

Dr. Bunce recorded a drop in mean fluoride levels in small mammals within one mile of the smelter from 1976 to 1982, (from 7700 ppm to 2945 ppm in deer mice). Smelter fluoride emissions have stabilized since 1982. It would be of some interest to determine if skeletal fluoride levels in other wildlife have likewise declined and if there are any signs of fluorosis or reproductive decline at the present levels.

There are active fur-bearer traplines in the Kitimat Valley with an estimated 200 marten per year taken. The Wildlife Section is planning a 5-year study on marten biology in co-operation with trappers from several northern valleys. They are interested in a co-operative study in the Kitimat Valley which would include skeletal fluoride analysis. The Conservation Officers in Terrace would freeze the carcasses, labeled as to trapping date and location. Wildlife Branch would do standard length and weight measurements and age the animal by tooth x-ray and annual cementum count. They would study the reproductive tract for sex and reproductive status and possibly do a stomach content analysis. WMB would do femur measurements and fluoride analysis on these specimens. Weight, femur size, age-distribution, and reproduction, as well as fluoride levels, could then be compared with other marten populations in the Region.

It was shown in captive white-tailed deer fed a high fluoride diet that fluoride accumulates rapidly in antlers. The deer accumulated nearly as much fluoride in antlers during the 5 month antler growth period of the second year as they did in the long bones over a 2 year period (Suttie, et al 1985). The possibility of using moose antlers as a monitoring tool could be explored by analysing antlers and, whenever possible, femurs from the estimated 5 male moose taken annually by hunters. If possible the animal should be aged as well. Moose may not prove to be a good animal to monitor however because it is only resident in the valley in the winter months.

Female black bear have a fairly restricted home range and consume large amounts of deciduous vegetation. Femurs could be obtained for analysis, taking care to exclude dump bears. If possible the animal should be aged and sexed.

Finally, it would be of interest to analyse the skeletal fluoride content of birds of prey, i.e., hawks and owls, in the Kitimat Valley, if the opportunity arises (i.e. a bird is accidently killed). It would be expected that several years would be required to accumulate sufficient data on wildlife fluoride loading.

5. RECOMMENDATIONS

1. The Waste Management Branch air monitoring trailer containing the continuous HF monitor should be moved north of the smelter in early March, and south of the smelter in early November to coincide with the prevailing winds. The greatest accumulation of fluoride appears to occur north of the smelter on the west side of the valley, so the trailer should be located as far to the west as possible during the summer. The Alcan continuous HF monitors located east of the Kitimat River are rarely in the plume path. Either fluoridation plates or foliage analysis could be used to monitor fluoride impingement on the forested sides of the valley, both north and south of the smelter.

2. The recent installation of an SO_2 continuous monitor in the Waste Management Branch trailer should determine if short-term "fumigation" events are responsible for SO_2-like foliar injury observed near the smelter. Monitoring could be carried out to determine the SO_2 impingement on forested areas with the use of sulfation plates. (Foliar analysis for SO_2 does not necessarily reflect short-duration fumigation events.)

3. The forest growth studies by Dr. Bunce appear to be monitoring the effect of fluoride on forest growth adequately and should be continued, with the addition of control sites which are clearly out of the influence of the smelter. A re-measurement of the area west and southwest of Lakelse Lake should be completed, since elevated fluoride concentrations were recorded there previously. Foliar fluoride analysis on the southeast side of Kitimat Arm (near Raley and Clio Points, for instance) would help delineate the extent of the plume path to the south as well as the degree of fluoride uptake during the winter.

4. Deciduous plant species measured in 1983 had fluoride levels exceeding the recommended criteria and had levels three to four times that of western hemlock at the same site. The present fluoride levels in deciduous vegetation should be determined and correlations with hemlock established. Leaf and stem collections should be made in the late fall at

sites along the west side of the valley with hemlock being sampled at the same sites as much as possible.

5. There is evidence of fluoride accumulation in the forest litter and soil. Researchers should be aware that most of this fluoride would be released suddenly in the event of wildfire. Little is known about the long term effect of this accumulation, however the community of the forest litter is essential to nutrient cycling in the forest.

6. A decrease from 1976 - 82 in skeletal fluoride loading in deer mice, red-backed voles and vagrant shrews has been indicated in studies by Dr. Bunce. The levels found in 1982 were still clearly elevated (20 times controls in deer mice). The small mammal study should be continued, with control sites which are clearly free of the influence of the smelter, and with sampling on the west side of the valley where foliage fluoride levels are highest. A larger sample size would help determine if voles are absent near the smelter as has been suggested by Bunce.

7. Elevated skeletal fluoride levels in several wildlife species were found in a Fish and Wildlife study in 1978-79. The highest levels were found 8 to 16 km north of the smelter on the west side of the valley in marten. A detailed study of skeletal fluoride loading in marten should be conducted to determine if elevated levels presently occur. The study would determine the age, sex, weight, and reproductive status of marten trapped in known locations throughout the valley, as well as femur dimensions and fluoride content. These parameters will be compared to populations elsewhere in the Region. It is also suggested that moose antlers and femurs of black bear, hawks and owls be collected when possible for fluoride analysis.

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APPENDIX I

FLUORIDATION INDEX AT KITIMAT, B.C.
Values in ug/dm^2/d

Equis Site No	Description	May '77	Jun '77	Jul '77	Aug '77	Sep '77	Oct '77	Nov '77	Dec '77	Jan '78	Feb '78	Mar '78
0435005	S Parking Lot	8.4	7.2	12.5	14.7		12.6	43.1	81.2	67	41.7	11.6
0435006	Smelter N Fence	171	229.5	189.2	137.1	113.2	151.7	70.9	8.9	18.9	21.4	75.5
0435008	Pollution Cont Ctr	.1	4.9		1.6	<.5	<.5	1.3	<.5	<.5	<.5	<.5
0435010	Northland Dock Rd	3.5	2.5	5	6	4.5	2.5	36.5	57.9	38.2	20.3	6.3
0435011	Anderson Cr Bridge	11.9	15.9	10.2	5.4	7.3	44.2	37.3	.5	.8	3.5	10
0435012	Water Tower	12	19.6	38.1	25.7	14.4	6.5	2.9	2.5	3.2	5.7	7.1
0435013	Old Trailer Court	49.4		71	31.6	19.6	12	3	1.6	2.3	3	10
0435014	Hydro Sub-Station	10.8	13.1	12.3	7	3.8	2.7	2	0.6	<.5	<.5	1.9
0435015	C N Crossing	20.5	35.4	28.2	15	7.2	35.1	5	1.5	0.9	4.4	5.6
0435016	Eurocan Burner	13.2	22.8	17.7	9.5	2.8	4.5	1.9	1	0.7	<.5	3.6
0435017	Doc's Cartage	5.1	13	8.4	4.7	2.5	9.7	3.1		1	1	2.7
0435018	Saunder's Workshop	4.4	12.3	7.3	4.3	2.4	5.9	3.5	<.5	<.5	<.5	2.7
0435019	Mi 3 Eurocan Road	1	3.8	2.8	2.1	<.5	.8	<.5	<.5		<.5	.7
0435020	Cable Car Subd		1	1.2	1		<.5	1.4	.6	<.5	<.5	<.5
0435021	End of Valley	3		2	1.3	<.5	<.5	4	<.5	<.5	<.5	<.5
0435022	Standard Station	3	8.6	4.8	3.2	1.5	8.4	7.6	<.5	.7	<.5	1.8
0435023	Water Pumphouse	1	5.2		1.3	.8	1	3.3	<.5	<.5	<.5	.8
0435024	Kildala School	2	3.1	2.4	2	.5		1.5	<.5	<.5	<.5	<.5
0435025	Public Safety Bldg	1	2	1.8	1.7	<.5	<.5	1	<.5		<.5	.6
0435026	Lahakas & Nalabila	1	2.3	2	1.7	<.5	1.3	1.4	.5	<.5	<.5	<.5
0435027	Alexander Elem Schl		2.2	1.7		<.5	<.5	<.5	<.5	<.5	<.5	
0435028	Northland Dock	4.7	3.7	6.7	7	11.7	4.9	12	51.7	54.9	32	7.7
0435040	Alcan Tour Bldg	46	58.4	69.4	33.2	17.8	13.3	3.7	1.3	2.1	2.4	7
0435041	Kitimat Village	1	4	2.6	2		.5	2.6	<.5	<.5	<.5	<.5
0430542	Minette Bay Midway	<.5	6.3	2.3	1.7	<.5	<.5	<.5	<.5	<.5	<.5	<.5
0435043	Minette Bay Marina	<.5	3.3	1.2	1.2	<.5	<.5	<.5	<.5	<.5	<.5	
0435044	Bish Cr	4	1.7			5.7						
0435045	Kitimat Arm	4	1.7			5.9						
0435046	Mi 6 Eurocan Rd	12	15.1	13.7	<.5	2.6	7	2.1	.6	1.3	1.3	4.3
0435047	Mi 9 Eurocan Rd	9	11.7	12.2	6.1	1.3	4.4	5.3	.8	<.5	<.5	3.5
0435048	Iron Mountain		4.4	4.8	2.8	<.5	1.3					

APPENDIX I

FLUORIDATION INDEX AT KITIMAT, B.C.
Values in $ug/dm^2/d$

Equis Site No	Description	Apr '78	May '78	Jun '78	Jul '78	Aug '78	Sep '78	Oct '78	Nov '78	Dec '78	Jan '79	Feb '79	Mar '79
0435005	S Parking Lot	18.4	2.6	7.3	2.2			2.3	57	22	13.5	73.5	29.4
0435006	Smelter N Fence	77.3	118.3	199	296.4	173.5		226.8	103	130	112.8	67.9	125.3
0435008	Pollution Cont Ctr	<.5		.8	.9	.7		<.5	<.5	1	<.5	.6	
0435010	Northland Dock Rd	8.	1.6	2.7	1.9	3		<.5	25	13	6.7	53.7	
0435011	Anderson Cr Bridge	7.7	7.7	11.3	6.4			29.3	11	46	15.9	9.3	
0435012	Water Tower	4.8	8.3	18.6	14.8	9.2		6.9	8	3	5	2.4	
0435013	Old Trailer Court	14.9	23.7	34.7	48	33.1	7	14.8	9	3	6.4	2.2	
0435014	Hydro Sub-Station	2.1	3.5	6.5	8.1	3.9	<.5	2.7	3	1	1.6	0.9	
0435015	C N Crossing	5.1	10.4	18.9	19.9	14.1	8	29.6	6	11	11.3	6.3	
0435016	Eurocan Burner	2.8	4.2	6	7.4	1.3		6.1	4	2	2.9	2.3	
0435017	Doc's Cartage	1.2	3.4	4.7	4.3			6.3	3	5	4.6	1.6	
0435018	Saunder's Workshop	2.6	4	5.1	4.8			5.2	2	4	3.8	.8	
0435019	Mi 3 Eurocan Road	<.5	.8					.5	<.5	2	2		
0435020	Cable Car Subd	<.5	<.5	<.5	.8	<.5		<.5	<.5	<.5	<.5	<.5	
0435021	End of Valley	<.5	1.2	<.5	.8	.5		<.5	<.5	1	.5	<.5	
0435022	Standard Station	1.9	1.7	3.1	2.5	2.4	<.5	3.2	1	3	2.9	1.4	
0435023	Water Pumphouse	<.5	.6	<.5	1.3	.8	<.5	<.5	<.5	2	.9	<.5	
0435024	Kildala School	<.5	.5	<.5	1.4	1.2	<.5	<.5	1	1	.5	<.5	
0435025	Public Safety Bldg	<.5	<.5	<.5	1.2	.9		<.5	<.5	<.5			
0435026	Lahakas & Nalabila	<.5	<.5	.7	1.7	.6	<.5	<.5	1	<.5	<.5		
0435027	Alexander Elem Schl	<.5		1.4				<.5	<.5	1	<.5	<.5	
0435028	Northland Dock	7.4	1.5	4.6	2.4	2.7	2	.9	18	14	10.5	23.9	
0435040	Alcan Tour Bldg	16.5	19.4	38.9	59.6	40.9		13.6	8	3	5.7	2	69.4
0435041	Kitimat Village	<.5	<.5	.9		1.6	<.5			<.5	<.5	.7	4
0430542	Minette Bay Midway	<.5	<.5	<.5	1.2	1	<.5	<.5	<.5	<.5	<.5	<.5	6.3
0435043	Minette Bay Marina	<.5	<.5			<.5		<.5	<.5	<.5	<.5	<.5	
0435044	Bish Cr												
0435045	Kitimat Arm												
0435046	Mi 6 Eurocan Rd	<.5	5.8	6.6	10.2	8.5	2	4.7	6	1.7	1.7		
0435047	Mi 9 Eurocan Rd	<.5	3.3	2.7	2.7	8.2	1	3.7	3				
0435048	Iron Mountain		1.1	2.9	1.7	1.2	<.5	.5					

APPENDIX 1

FLUORIDATION INDEX SMELTER NORTH FENCE
AND SOUTH PARKING LOT
1976-1985

F:Index in ug/(dm^2.d)

0435006 - Smelter North Fence

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1977	45.3	95.4	150.0	178.1	171.0	229.5	189.2	137.1	113.2	151.7	70.9	8.9
1978	18.9	21.4	75.5	77.3	118.3	199.0	296.4	173.5		226.8	103.0	130.0
1979	112.8	67.9	125.3	167.0	302.8	256.4	204.2	249.0	121.7	77.6	71.4	97.4
1980	78.0	27.5	89.2	64.7	81.8	157.1	193.0			92.9	73.2	147.6
1981	11.3	44.8	57.8	80.7	62.0	88.5	110.3	63.0	99.7	122.3	48.0	37.3
1982			61.3	100.7	97.5	132.5	126.0	138.0	77.7	28.6	28.6	6.8
1983	97.9	12.9	11.3	72.0	147.0		134.9		130.0	44.4	3.8	48.3
1984	109.2	100.0	34.0	86.3	101.9	165.2	9.0			34.2	106.9	59.6
1985	30.8	207.4	132.0	160.0	115.0	131.0	130.0		37.4	121.0		46.8
	0435005 - South Parking Lot											
1977	60.9		8.8		8.4	7.2	12.5	14.7		12.6	43.1	81.2
1978	67.0	41.7	11.6	18.4	2.6	7.3	2.2			2.3	57.0	22.0
1979	13.5	73.5	29.4	59.6	3.5	4.8	6.2	18.4	2.7	14.5	10.0	31.6
1980		96.7	10.2	11.8	7.2	10.2	2.3			6.0	63.8	72.4
1981	7.9	18.0	4.7	15.3	2.3	2.0	3.8	6.8	6.4	4.9	11.5	33.5
1982	29.5	29.5		5.5	5.2	4.9		1.6	8.7	6.7	6.7	16.3
1983	31.4	14.6	16.3	9.0	5.0		3.9		2.0	12.6	16.6	
1984		3.2	8.2	<.5	2.4	<.5	<.5			41.4	29.9	43.4
1985	66.0	<.5	11.6	2.4	5.9	4.9	7.6	5.8	25.4	6.9		15.1

APPENDIX 2

CLIMATE DATA, KITIMAT TOWNSITE

APPENDIX 2

WIND SUMMARY DURING STUDY PERIOD AT KITIMAT TOWNSITE

		Direction SE/S/SW % Frequency	Mean Speed km/hr	Direction NE/N/NW % Frequency	Mean Speed km/hr
1977	05*	70%	11.9	26%	9.6
	06	93%	12.6	2%	3.1
	07	85%	13.0	10%	7.1
	08	55%	11.3	39%	9.7
	09	46%	9.9	50%	8.6
	10	53%	10.7	39%	8.2
	11	46%	14.0	52%	14.2
	12*	22%	12.7	62%	16.9
1978	01	11%	9.2	86%	23.1
	02	14%	7.1	83%	15.7
	03	35%	9.5	60%	10.3
	04	58%	10.8	39%	11.8
	05	74%	11.1	16%	6.2
	06	75%	13.8	22%	9.4
	07	82%	14.0	17%	7.2
	08	72%	12.1	12%	8.8
	09	54%	9.2	41%	10.2
	10	72%	11.8	26%	6.2
	11	47%	12.1	53%	17.4
	12	55%	13.6	44%	16.4
1979	01	29%	12.3	71%	21.6
	02*	31%	10.7	63%	15.7
	03*	48%	11.3	46%	13.7

Mar - Oct Mean Southerly Speed - 11.5 km/hr.
Mar - Oct Mean Northerly Speed - 8.7 km/hr.
Nov - Feb Mean Southerly Speed - 11.4 km/hr.
Nov - Feb Mean Northerly Speed - 17.6 km/hr.

* Wind data not available. Substituted average monthly data for 1967 - 80 period (Atmospheric Environment Service, Canadian Climate Normals, Vol. 5, 1982)

An example of the Calibration factor (Lynch et al, 1978) is shown below:
$C = 0.087 \times (V/4.7)\ 1/2(ug/m^3)/(uf/dm^2)$ where
V = mean wind speed in miles/hr.
June 1977 mean southerly wind speed = 12.6 km/hr
12.6 km/hr x 0.6214 = 7.8 mi/hr
C = 0.087 x (7.8/4.7)1/2
C= 0.112

TABLE/TABLEAU 5

WIND VENT

STATION	HOURS / HEURES	PREVAILING DIRECTION / DIRECTION DOMINANTE	MEAN SPEED / VITESSE MOYENNE km/h	MAXIMUM HOURLY WIND / VENT MAXIMAL HORAIRE SPEED / VITESSE km/h	DIRECTION	DATE	PEAK SPEED / VITESSE DE POINTE SPEED / VITESSE km/h	DIRECTION	DATE	SPEED CLASSES (%) / CLASSES DE VITESSE (%) km/h: CALM / CALME	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61
BRITISH COLUMBIA COLOMBIE-BRITANNIQUE																		
NOVEMBER 1977 NOVEMBRE																		
BURNABY MTN SCHPA	661	E	17.6	64	SE	01	M			1	8	23	34	19	10	4	1	+
CARNATION CREEK CDF	720	E	13.3	66	S	01	M				19	38	28	10	4	2	1	+
MT KOBAU OBSERVATORY	720	S	20.1	65	SW	14	M			+	4	23	31	21	14	4	2	1
SAND HEADS LIGHTSTATION	720	E	25.7	71	SE	121	M			1	5	9	23	23	21	12	6	1
DECEMBER 1977 DECEMBRE																		
BURNABY MTN SCHPA	744	N	13.6	61	E	101	M			7	17	30	23	11	9	3	+	
CAPE BEALE LIGHT	744	NE	17.5	74	W	08	M			+	16	33	18	13	10	6	3	1
CARNATION CREEK CDF	744	E	13.0	48	W	081	M				20	35	30	9	4	2		
KITIMAT TOWNSITE	739	NE	16.8	47	NE	054	M			1	14	22	27	21	11	4		
MT KOBAU OBSERVATORY	744	S	16.3	46	SW	07	M			3	8	23	34	21	9	2		
JANUARY 1978 JANVIER																		
ROSE SPIT (AUT)	410	M	M	M			M			M	M	M	M	M	M	M	M	M
FEBRUARY 1978 FEVRIER																		
ROSE SPIT (AUT)	575	SE	28.5	65	E	09	M			+	1	3	7	18	22	22	18	9
ALBERTA ALBERTA																		
NOVEMBER 1977 NOVEMBRE																		
HIGHVALE	547	M	M	M			M			M	M	M	M	M	M	M	M	M
DECEMBER 1977 DECEMBRE																		
HIGHVALE	412	M	M	M			M			M	M	M	M	M	M	M	M	M

AVERAGE SPEED IN km/h / VITESSE MOYENNE EN km/h — PERCENTAGE FREQUENCY OF DIRECTION / FREQUENCE DE LA DIRECTION EN POURCENTAGE

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
13.2 15		16.8 14		16.1 27		16.8 8		20.5 11		25.3 13		7.8 3		14.0 8	
10.1 5		9.8 20		8.8 27		11.8 7		16.0 30		20.5 11		16.4 9		8.5 1	
16.2 1		11.1 4		10.7 8		16.3 16		18.3 32		28.2 16		21.4 12		24.8 13	
14.1 3		16.4 2		23.8 44		35.8 12		25.8 12		25.7 9		28.3 10		30.4 7	
9.3 16		14.4 13		17.0 14		22.4 4		16.8 13		16.8 10		7.9 8		12.4 16	
4.8 5		11.0 27		7.8 14		20.5 22		20.3 6		28.1 9		31.5 12		25.4 9	
10.5 6		12.0 27		10.1 31		6.8 4		17.1 17		17.3 6		20.3 9		8.0 +	
13.3 35		20.8 56		2.7 1		9.0 1		4.9 4		8.1 2		3.0 +		.8	
19.8 9		7.3 1		7.8 1		16.2 9		15.8 40		22.0 9		13.9 11		16.3 17	
M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M
27.9 14		20.6 6		39.6 26		49.0 35		29.6 10		16.6 1		33.8 4		26.4 4	
M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M
M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M

VITESSE MOYENNE EN km/h — FREQUENCE DE LA DIRECTION EN POURCENTAGE

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
13.2 15		16.8 14		16.1 27		16.8 8		20.5 11		25.3 13		7.8 3		14.0 8	
10.1 5		9.8 20		8.8 27		11.8 7		16.0 30		20.5 11		16.4 9		8.5 1	
16.2 1		11.1 4		10.7 8		16.3 16		18.3 32		28.2 16		21.4 12		24.8 13	
14.1 3		16.4 2		23.8 44		35.8 12		25.8 12		25.7 9		28.3 10		30.4 7	
9.3 16		14.4 13		17.0 14		22.4 4		16.8 13		16.8 10		7.9 8		12.4 16	
4.8 5		11.0 27		7.8 14		20.5 22		20.3 6		28.1 9		31.5 12		25.4 9	
10.5 6		12.0 27		10.1 31		6.8 4		17.1 17		17.3 6		20.3 9		8.0 +	
13.3 35		20.8 56		2.7 1		9.0 1		4.9 4		8.1 2		3.0 +		.8	
19.8 9		7.3 1		7.8 1		16.2 9		15.8 40		22.0 9		13.9 11		16.3 17	
M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M
27.9 14		20.6 6		39.6 26		49.0 35		29.6 10		16.6 1		33.8 4		26.4 4	
M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M
M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M

1 FIRST OF SEVERAL / PREMIERE DE PLUSIEURS

ON INDIQUE UN VENT D'OUEST PAR LA LETTRE "W"

+ LESS THAN 0.5 PERCENT BUT NOT ZERO / INFERIEURE A 0.5 POURCENT MAIS SUPERIEURE A ZERO

STATION	HOURS / HEURES	PREVAILING DIRECTION / MEAN SPEED — DIRECTION DOMINANTE / VITESSE MOYENNE km/h		MAXIMUM HOURLY WIND / VENT MAXIMAL HORAIRE — SPEED / VITESSE km/h	DIRECTION	DATE	PEAK SPEED / VITESSE DE POINTE — SPEED / VITESSE km/h	DIRECTION	DATE
BRITISH COLUMBIA / COLOMBIE-BRITANNIQUE									
DRYAD POINT	739	SE	10.6	31	NE	03	M		
DUNCAN LAKE DAM	700	E	7.6	35	SW	22	M		
EGG ISLAND	744	SE	16.2	58	SE	07	M		
ENTRANCE ISLAND	621	M	M	51	E	05	M		
ESTEVAN POINT	744	ESE	17.8	69	NW	21‡	107	ESE	07
ETHELDA BAY	744	NE	15.4	40	NE	05	M		
FORT NELSON A	744	N	3.0	22	SE	07‡			
FORT ST JOHN A	744	N	11.9	43	WSW	23	56	WSW	23
GERMANSEN LANDING	744	SE	3.4	14	SE	21	M		
HOPE A	744	ESE	16.9	37	WNW	06	80	WNW	05
HUDSON HOPE BONPA DAM	729	W	7.2	35	NW	02	M		
KAMLOOPS A	744	E	9.4	37	ESE	07‡	48	ESE	21
KITIMAT TOWNSITE	731	NE	21.1	46	NE	07‡	M		
LAWYER ISLAND	741	NE	24.1	56	NE	07	M		
LENNARD ISLAND	744	SE	14.3	51	S	05	M		
LUCY ISLAND	743	SE	16.9	64	SE	23	M		
MACKENZIE A	740	NNW	5.6	33	N	04	62	NNE	05
MONNIES ISLAND	744	SVL	18.3	42	NE	04	M		
MERRY ISLAND	744	NW	11.6	58	E	05	M		
MICA DAM	741	N	12.7	47	N	31	M		
MT ROBAU OBSERVATORY	741	S	14.4	39	S	02	M		

SPEED CLASSES (%) / CLASSES DE VITESSE (%) — km/h

CALM / CALME	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61
1	32	26	31	10	+			
1	41	40	15	2	1			
+	9	32	34	11	9	5	+	
M	M	M	M	M	M	M	M	M
14	8	21	22	18	9	6	3	1
+	11	30	33	17	9	+		
59	12	25	4	+				
5	12	37	31	13	2	+		
14	68	18	+					
7	4	8	26	39	13			
9	42	30	15	2	2			
29	5	30	24	11	1			
	8	17	24	18	26	6		
	2	9	21	36	24	7	1	
2	22	24	27	15	7	3	+	
+	23	31	19	8	8	5	4	2
37	12	38	12	1	+			
	6	26	30	19	17	2		
+	24	46	18	4	4	3	1	
1	24	36	18	11	9	1		
1	11	36	25	20	7	+		

AVERAGE SPEED IN km/h / PERCENTAGE FREQUENCY OF DIRECTION — VITESSE MOYENNE EN km/h / FREQUENCE DE LA DIRECTION EN POURCENTAGE

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
41 8		10.8 15		12.1 31		13.0 34		7.3 4		3.4 2		2.6 1		3.5 4	
3.3 4		8.0 19		8.6 51		5.0 +		5.0 +		13.7 4		5.2 19		3.7 2	
5.0 +		12.7 1		11.6 31		18.8 58		9.9 3		17.9 5		22.4 2		0	
M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M
9.8 2	7.5 1	8.5 2	10.5 7	14.1 18	22.9 24	27.6 15	18.6 3	34.6 2	43.5 1	23.3 +	12.0 +	20.3 1	37.4 3	29.7 4	9.8 3
7.5 4		17.1 67		9.6 12		17.2 8		18.5 3		12.6 1		4.6 1		6.6 3	
6.9 6	6.3 4	4.8 2	5.3 1	6.3 1	10.0 3	11.2 4	6.7 2	4.7 4	7.2 6	4.7 1	5.3 1	4.3 1	4.0 +	7.4 1	8.7 4
14.8 23	12.1 3	9.6 3	12.7 3	8.4 5	12.2 11	12.9 9	7.6 3	7.5 3	8.8 2	9.9 5	16.7 7	16.1 9	8.6 2	6.6 3	11.3 3
3.6 1		5.7 3		3.3 15		5.5 29		2.6 4		2.8 12		2.7 19		5.0 3	
0	2.0 +	11.0 +	10.4 1	17.4 26	23.2 39	23.6 16	13.5 +	5.5 1	6.3 2	8.1 2	11.5 1	15.9 3	23.1 2	7.0 +	0
7.6 3		11.2 8		8.8 16		8.9 13		2.3 1		4.7 7		4.8 26		11.6 17	
6.2 1	7.0 +	8.0 +	9.9 5	12.9 30	16.4 18	14.2 3	7.6 +	0	7.5 1	7.2 2	11.4 3	13.8 8	11.8 1	8.0 1	6.0 +
16.6 21		25.2 66		14.2 3		11.7 1		7.4 5		10.5 5		5.0 +		3.0 +	
9.3 +		29.0 44		20.0 21		22.6 30		7.5 1		10.2 3		9.0 +		8.3 1	
8.0 2		4.6 2		11.2 32		16.2 47		15.4 5		20.9 3		7.0 1		23.6 6	
13.8 24		15.4 19		11.9 14		27.4 29		8.1 4		7.1 2		11.1 4		7.0 4	
11.2 6	15.3 1	2.7 +	12.0 +	7.1 2	7.2 6	7.4 8	6.3 1	4.0 +	12.0 +	9.0 +	12.0 1	6.9 2	8.2 3	9.8 11	9.1 20
10.0 6		25.1 38		14.9 35		11.4 10		24.0 3		10.1 1		5.0 1		14.5 2	
6.4 22		6.8 2		20.6 20		17.3 13		11.2 2		14.8 2		7.0 5		8.8 34	
18.6 42		11.9 4		2.0 +		7.5 33		9.8 10		14.1 3		4.3 1		8.1 6	
7.4 2		5.2 1		8.3 5		11.9 16		14.4 44		12.2 3		10.9 5		20.0 23	

‡ POINT OF SEVERAL / PRESENCE DE PLUSIEURS

ON INDIQUE UN VENT D'OUEST PAR LA LETTRE "W"

+ LESS THAN 0.5 PERCENT BUT NOT ZERO / INFERIEURE A 0.5 POURCENT MAIS SUPERIEURE A ZERO

WIND VENT

TABLE/TABLEAU 5

STATION	HOURS / HEURES	PREVAILING DIRECTION / DIRECTION DOMINANTE	MEAN SPEED / VITESSE MOYENNE km/h	MAXIMUM HOURLY WIND / VENT MAXIMAL HORAIRE SPEED / VITESSE km/h	DIRECTION	DATE	PEAK SPEED / VITESSE DE POINTE SPEED / VITESSE km/h	DIRECTION	DATE
BRITISH COLUMBIA / COLOMBIE-BRITANNIQUE									
DRYAD POINT	672	SE	12 8	53	SE	09	M		
DUNCAN LAKE DAM	648	E	6 7	35	SW	11	M		
EGG ISLAND	672	SE	25 4	78	SE	08	M		
ENTRANCE ISLAND	672	SE	18 5	50	SE	08	M		
ESTEVAN POINT	670	ESE	23 9	86	SE	04	148	SE	07
ETHELDA BAY	672	NE	14 4	32	S	05	M		
FORT NELSON A	672	SSW	3 7	37	ENE	26	59	ENE	26
FORT ST JOHN A	672	ESE	15 5	44	WSW	22	63	SW	22
GERMANSEN LANDING	672	SE	4 5	18	NW	22	M		
HOPE A	672	E	12 6	30	E	02	48	WNW	09
HUDSON HOPE BCHPA DAM	667	E	8 1	32	W	17	M		
KAMLOOPS A	672	E	8 9	35	ESE	08	43	E	06‡
KITIMAT TOWNSITE	668	NE	14 0	45	NE	01	M		
LAWYER ISLAND	672	SE	20 6	45	SE	19	M		
LENNARD ISLAND	672	SE	16 5	55	S	06	M		
LUCY ISLAND	672	SE	26 9	71	SE	17‡	M		
MACKENZIE A	664	S	4 9	37	NE	26	72	NE	27
MCINNES ISLAND	672	E	16 4	56	S	09	M		
MERRY ISLAND	672	E	15 7	69	SE	08	M		
MICA DAM	623	N	11 0	45	N	26	M		
MT KOBAU OBSERVATORY	672	S	13 5	35	NW	19	M		

STATION	SPEED CLASSES (%) / CLASSES DE VITESSE (%) km/h: CALM / CALME	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61
BRITISH COLUMBIA / COLOMBIE-BRITANNIQUE									
DRYAD POINT	1	21	26	38	11	3	+	+	
DUNCAN LAKE DAM	2	52	33	11	1	1			
EGG ISLAND		3	19	20	15	26	12	4	1
ENTRANCE ISLAND	+	13	24	32	18	8	5	+	
ESTEVAN POINT	7	4	18	18	16	19	10	5	3
ETHELDA BAY		8	33	38	20	1			
FORT NELSON A	49	18	26	6	1	+			
FORT ST JOHN A	2	7	29	34	24	4	+		
GERMANSEN LANDING	9	61	26	4					
HOPE A	10	8	27	36	19	+			
HUDSON HOPE BCHPA DAM	2	39	38	16	3	+			
KAMLOOPS A	31	9	27	20	12	1			
KITIMAT TOWNSITE	2	22	24	25	20	5	2		
LAWYER ISLAND	+	10	10	26	32	20	2		
LENNARD ISLAND	2	19	18	25	22	10	3	1	
LUCY ISLAND		6	16	16	16	21	14	9	2
MACKENZIE A	43	17	26	9	2	1			
MCINNES ISLAND		7	27	33	25	8	+	+	
MERRY ISLAND	+	19	35	20	10	6	6	3	1
MICA DAM	1	23	43	19	12	2	+		
MT KOBAU OBSERVATORY	2	9	33	41	13	2			

AVERAGE SPEED IN km/h / VITESSE MOYENNE EN km/h — PERCENTAGE FREQUENCY† OF DIRECTION / FREQUENCE DE LA DIRECTION EN POURCENTAGE

STATION	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
BRITISH COLUMBIA / COLOMBIE-BRITANNIQUE																
DRYAD POINT	6 2 10		8 4 3		13 1 25		15 8 40		17 6 8		7 2 2		5 8 1		6 3 10	
DUNCAN LAKE DAM	3 3 2		6 8 18		6 9 46		3 7 +		3 0 +		10 3 14		4 5 15		3 3 2	
EGG ISLAND	0		0		10 7 15		30 1 70		20 8 4		19 7 8		10 7 3		10 0 +	
ENTRANCE ISLAND	6 4 3		6 1 1		15 9 10		20 2 40		11 5 13		5 6 1		9 4 13		20 7 19	
ESTEVAN POINT	9 4 3	10 3 1	9 0 2	10 8 5	13 8 11	27 8 29	37 0 19	36 7 5	35 9 4	26 9 2	20 7 1	14 3 1	10 8 1	16 5 2	21 8 3	18 8 4
ETHELDA BAY	9 3 10		15 0 31		9 4 18		17 1 24		20 6 12		17 3 1		10 0 1		9 1 3	
FORT NELSON A	6 3 4	5 6 2	8 3 1	8 1 1	9 9 3	10 9 4	9 2 3	5 2 1	5 7 6	7 2 10	5 9 4	5 7 3	4 3 2	4 7 +	6 9 1	8 8 5
FORT ST JOHN A	18 2 12	10 7 2	9 3 1	10 4 2	17 2 9	16 0 20	14 2 12	9 2 3	8 9 4	9 6 3	16 6 6	21 9 12	12 9 5	8 5 1	13 4 2	18 2 4
GERMANSEN LANDING	3 4 2		6 3 3		4 0 17		6 9 34		3 3 2		2 9 7		2 9 18		5 2 8	
HOPE A	0	0	8 2 1	10 7 4	13 7 40	16 4 26	16 0 9	12 4 1	4 3 2	5 5 2	6 2 3	8 4 +	13 2 1	17 8 1	0	0
HUDSON HOPE BCHPA DAM	5 0 3		7 1 14		9 2 26		11 3 14		3 8 2		7 5 8		6 6 19		9 1 10	
KAMLOOPS A	5 0 1	4 0 1	8 7 1	12 4 7	15 4 25	12 0 10	8 9 4	4 3 1	4 7 +	7 3 +	8 0 +	11 5 3	13 7 12	10 2 3	8 1 1	7 5 +
KITIMAT TOWNSITE	12 2 24		17 4 57		4 3 2		5 1 2		6 3 6		10 0 5		2 4 1		3 8 1	
LAWYER ISLAND	5 9 4		24 9 29		13 9 8		23 2 48		4 9 1		8 4 3		6 5 2		10 9 7	
LENNARD ISLAND	3 8 1		4 9 5		13 1 25		21 1 49		23 7 6		13 5 4		8 2 2		10 1 6	
LUCY ISLAND	18 5 18		11 5 7		10 9 7		34 7 57		31 4 4		11 2 1		15 3 2		16 5 4	
MACKENZIE A	7 4 9	10 1 8	15 5 3	14 5 2	8 5 2	5 4 3	5 4 2	8 7 7	9 3 10	7 0 1	5 0 1	12 0 +	5 4 2	6 0 1	5 5 3	7 5 3
MCINNES ISLAND	13 8 9		20 8 14		14 3 28		11 7 20		23 0 20		20 3 2		8 1 1		13 3 6	
MERRY ISLAND	7 5 13		6 1 3		22 5 35		22 8 15		7 7 3		6 7 1		7 1 5		10 6 25	
MICA DAM	14 2 43		12 1 3		3 0 +		7 6 30		7 1 10		15 3 8		2 5 1		6 6 4	
MT KOBAU OBSERVATORY	12 8 13		8 1 2		6 2 2		14 8 19		13 1 35		11 1 4		12 8 6		16 7 17	

‡FIRST OF SEVERAL / PREMIERE DE PLUSIEURS

ON INDIQUE UN VENT D'OUEST PAR LA LETTRE "W"

+LESS THAN 0.5 PERCENT BUT NOT ZERO / INFERIEURE A 0.5 POURCENT MAIS SUPERIEURE A ZERO

STATION	HOURS	HEURES	PREVAILING DIRECTION / MEAN SPEED / DIRECTION DOMINANTE / VITESSE MOYENNE km/h	MAXIMUM HOURLY WIND / VENT MAXIMAL HORAIRE: SPEED VITESSE km/h	DIRECTION	DATE	PEAK SPEED / VITESSE DE POINTE: SPEED VITESSE km/h	DIRECTION	DATE	SPEED CLASSES (%) / CLASSES DE VITESSE (%) km/h: CALM CALME	1-5	6-11	12-19	20-28	29-38	39-49	50-61	-61	AVERAGE SPEED IN km/h / PERCENTAGE FREQUENCY OF DIRECTION / VITESSE MOYENNE EN km/h / FREQUENCE DE LA DIRECTION EN POURCENTAGE: N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
BRITISH COLUMBIA COLOMBIE-BRITANNIQUE																														
DRYAD POINT	737	SE	10 4	42	SE	24	M			2	,34	27	28	8	1	+			5 4 9		4 1 4		9 5 14		13 8 43		14 0 11		5 1 4		2 6 2		7 0 11	
DUNCAN LAKE DAM	724	E	7 5	40	SW	24‡	M			2	47	38	8	1	3	1			4 6 5		6 2 17		7 9 30		3 7 1		4 3 1		16 3 13		5 5 29		3 4 2	
EGG ISLAND	744	SE	21 3	74	SE	06	M				6	24	27	17	14	8	3	1	0		3 0 +		9 5 12		26 0 55		10 9 6		20 0 23		17 5 4		0	
ENTRANCE ISLAND	744	NW	17 8	50	E	07‡	M			+	15	23	23	20	14	5	+		7 8 2		5 7 +		21 3 11		20 9 27		13 8 8		8 5 1		11 6 21		20 1 30	
ESTEVAN POINT	744	NW	24 5	67	WNW	11	141	ESE	07	8	4	17	20	14	16	10	7	4	9 5 3	8 6 1	8 3 1	12 3 3	10 1 7	30 3 16	31 5 15	30 9 6	28 8 7	21 8 1	9 9 1	14 8 1	13 3 1	32 4 5	33 0 18	19 7 8
ETHELDA BAY	744	NE	11 5	32	SE	06	M			+	22	35	34	8	1				7 0 12		10 1 20		7 6 13		16 1 18		15 2 20		13 3 5		8 5 7		8 8 5	
FORT NELSON A	744	N	5 4	32	N	01	43	N	01‡	38	15	34	10	3	+				10 6 12	9 0 8	7 6 2	7 0 2	7 2 4	6 6 3	5 8 3	5 6 3	7 9 4	8 0 6	7 6 3	6 6 3	12 7 2	17 6 2	9 9 2	11 0 3
FORT ST JOHN A	744	N	14 0	56	N	01	67	N	01	3	5	39	32	18	3	+	+		17 1 19	8 9 2	7 6 3	8 3 1	12 2 5	11 5 10	9 5 5	8 4 1	9 3 2	11 5 2	14 7 6	17 8 16	17 2 15	12 6 2	8 5 3	13 8 5
GERMANSEN LANDING	744	SE	5 0	18	NE	01‡	M			5	63	27	5						3 1 3		9 1 4		4 3 11		6 7 27		3 2 5		3 6 9		3 2 17		6 4 19	
HOPE A	734	E	9 7	33	W	19	54	WNW	13	14	15	34	28	9	+				4 0 +	0	9 5 1	9 1 5	11 2 25	13 3 12	13 0 4	5 8 1	7 1 2	6 1 4	5 7 6	7 2 5	13 9 10	16 2 10	7 7 1	0
HUDSON HOPE BCHPA DAM	719	W	8 2	39	W	20	M			10	40	26	14	8	2	+			4 6 6		7 0 10		9 3 16		10 2 11		3 9 1		10 2 11		11 3 24		7 1 11	
KAMLOOPS A	744	ESE	11 5	37	ESE	16‡	56	ESE	16‡	21	7	28	24	15	5				9 0 +	8 5 1	10 0 +	10 2 3	14 2 19	15 8 24	13 4 5	13 7 1	12 7 2	12 4 1	20 3 1	12 4 3	16 0 12	15 4 5	7 3 2	8 3 +
KITIMAT TOWNSITE	699	NE	9 8	34	N	02‡	M			3	29	39	19	7	3				9 8 27		11 0 33		3 6 1		8 0 5		8 1 16		11 7 15		3 3 1		5 5 +	
LAWYER ISLAND	744	SE	17 6	47	SE	06‡	M			+	8	24	31	21	13	3			8 6 3		24 5 11		13 0 11		20 4 58		3 9 1		7 8 5		6 3 2		10 6 9	
LENNARD ISLAND	370	M	M	M			M			M	M	M	M	M	M	M	M	M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M
LUCY ISLAND	744	SE	25 4	68	SE	08	M				8	20	18	16	12	14	10	2	15 4 9		8 8 2		7 9 7		34 9 53		23 0 8		11 6 2		11 1 8		15 9 11	
MACKENZIE A	738	S	5 4	32	E	01	70	ENE	01	37	15	37	10	1	+				8 2 8	9 1 7	6 7 2	11 4 1	10 2 3	5 2 1	6 4 4	7 6 7	9 9 14	9 3 4	8 1 1	9 3 2	8 9 3	6 4 2	4 7 1	7 7 3
MCINNES ISLAND	744	S	14 0	40	SW	25‡	M				11	38	31	13	6	1			10 7 10	-	17 1 10		9 2 16		11 9 19		19 5 20		17 7 6		9 7 5		14 0 14	
MERRY ISLAND	744	NW	18 5	61	E	07‡	M			1	18	34	18	8	14	4	3		6 0 8		7 8 2		27 6 29		22 1 12		5 7 3		6 0 3		8 7 7		12 4 35	
MICA DAM	720	SE	10 8	34	N	02‡	M			1	17	51	20	8	3				14 2 25		10 7 2		4 8 1		8 8 36		9 2 12		15 3 15		3 5 +		6 4 8	
MT KOBAU OBSERVATORY	744	S	16 0	47	NW	30‡	M			1	9	26	37	18	8	1			11 0 6		8 2 1		11 0 5		14 6 20		15 9 28		14 2 8		13 9 8		21 9 23	

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WIND VENT

STATION	HOURS / HEURES	PREVAILING DIRECTION / MEAN SPEED / DIRECTION DOMINANTE / VITESSE MOYENNE km/h		MAXIMUM HOURLY WIND / VENT MAXIMAL HORAIRE			PEAK SPEED / VITESSE DE POINTE			SPEED CLASSES (%) / CLASSES DE VITESSE (%) km/h									AVERAGE SPEED IN km/h / PERCENTAGE FREQUENCY OF DIRECTION / VITESSE MOYENNE EN km/h / FREQUENCE DE LA DIRECTION EN POURCENTAGE														
				SPEED VITESSE km/h	DIRECTION	DATE	SPEED VITESSE km/h	DIRECTION	DATE	CALM CALME	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
BRITISH COLUMBIA / COLOMBIE-BRITANNIQUE																																
DRYAD POINT	717	SE	7.7	35	S	17	M			2	42	36	18	2	+				6.3 15		7.5 6		9.3 11		10.0 19		7.6 10		6.5 12		2.9 1		7.5 10	
DUNCAN LAKE DAM	720	SW	11.0	56	SW	16	M				32	35	19	7	6	1	+		3.6 3		11.1 22		8.6 18		3.0 +		7.6 1		17.9 36		5.9 25		2.5 1	
EGG ISLAND	720	SE	14.6	56	SE	17	M			+	12	34	34	12	6	2	+		0		0		11.6 20		17.9 34		6.5 7		14.0 25		13.9 11		15.6 3	
ENTRANCE ISLAND	720	SE	19.1	51	SE	05	M			+	11	20	26	20	14	7	+		11.7 4		4.0 1		21.1 14		20.0 32		10.3 8		9.2 3		16.5 16		25.0 22	
ESTEVAN POINT	720	NW	24.0	65	WNW	10[	111	SE	04	6	4	17	21	16	15	13	6	2	6.9 1	5.4 1	8.8 3	10.1 4	15.6 11	26.1 14	27.9 11	31.6 7	19.8 6	15.1 2	8.2 1	12.3 +	12.1 1	30.3 11	36.6 16	21.7 5
ETHELDA BAY	720	NE	9.4	27	NE	13	M			1	26	47	21	5					6.4 12		11.7 18		6.0 14		11.1 15		11.0 16		9.9 5		9.2 12		8.6 7	
FORT NELSON A	720	N	8.0	33	N	10	52	WNW	08	25	12	37	18	6	+				13.0 16	10.6 5	6.3 2	7.3 3	7.8 4	9.3 5	9.2 5	8.0 4	6.6 6	6.8 2	6.0 1	7.9 2	13.0 4	16.2 4	16.1 3	12.8 9
FORT ST JOHN A	720	N	11.0	33	N	05[	52	WSW	10	5	8	53	23	10	1				13.7 22	7.5 5	7.9 4	8.3 4	8.5 6	10.6 9	10.1 5	10.1 3	9.5 3	9.7 2	13.3 5	16.4 6	14.1 7	12.1 2	7.6 2	12.6 6
GERMANSEN LANDING	720	SE	6.4	18	NW	11	M			4	56	33	5						3.3 2		9.2 9		4.6 18		5.7 28		3.6 6		4.3 6		3.6 11		7.1 17	
HOPE A	720	E	11.0	39	WNW	10[	05	W	11	10	13	30	32	14	1	+			26.0 +	2.0 +	9.2 2	11.8 7	11.6 20	9.6 6	10.8 2	6.0 1	5.1 2	5.2 4	6.4 6	7.8 3	16.6 17	16.3 15	18.6 4	16.6 1
HUDSON HOPE BCHPA DAM	720	E	7.2	35	W	10[	M			23	30	27	12	6	2				6.1 5		7.6 16		7.3 18		11.7 11		3.6 1		12.3 8		13.0 13		6.1 5	
KAMLOOPS A	720	W	12.4	46	W	10	09	N	10	13	6	26	33	14	3	1			8.1 1	6.0 1	6.3 1	12.0 3	13.0 12	16.6 12	16.6 10	15.2 6	6.0 3	16.6 1	9.1 1	12.0 4	14.9 16	15.6 6	14.6 6	13.2 2
KITIMAT TOWNSITE	671	SW	11.2	29	NE	13[	M			+	25	34	32	6	1				13.0 14		10.6 24		3.5 2		10.2 7		9.3 23		13.0 29		2.5 +		4.6 1	
LAWYER ISLAND	720	SE	13.0	46	SE	09[	M			+	18	30	22	13	6	2			7.0 6		18.9 7		7.4 9		16.3 47		4.2 2		10.5 12		7.1 5		10.7 12	
LEBHARD ISLAND	564	M	M	56	NW	10	M			M	M	M	M	M	M	M	M	M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M
LUCY ISLAND	720	SE	17.6	77	SE	09	M				15	31	25	11	9	5	1	3	14.5 15		10.7 4		9.6 8		27.0 29		16.3 18		8.0 5		16.5 16		11.7 8	
MACKENZIE A	708	S	7.4	33	NE	14[	56	NNE	13	29	12	37	17	5	+				8.1 7	11.2 5	10.5 5	12.9 6	14.1 8	10.7 1	6.3 2	7.5 6	11.2 12	9.3 4	9.3 2	8.4 1	8.3 3	10.6 3	9.3 3	7.5 3
MORRIES ISLAND	720	S	10.5	37	S	04	M			+	21	52	17	7	3				9.2 8		16.9 14		8.6 16		8.0 12		12.2 17		8.4 11		8.6 9		9.6 13	
MERRY ISLAND	720	E	19.3	66	SE	05	M			+	9	28	23	15	13	11	1		9.0 7		12.6 1		23.5 32		24.0 20		13.5 3		8.6 3		8.4 4		17.3 30	
MT KOBAU OBSERVATORY	720	NW	17.4	50	W	10	M			+	5	24	41	17	11	2	+		19.7 6		11.7 3		12.4 10		13.2 24		13.9 16		12.5 4		17.7 5		24.5 32	
MULE CREEK	666	S	12.9	46	SE	07	M			4	26	23	20	15	8	2			4.1 7		4.1 1		9.2 4		17.0 23		12.7 34		4.6 4		4.8 2		17.4 21	

SPEED OF REVERSAL / PREMIERE DE PLUSIEURS

ON INDIQUE UN VENT D'OUEST PAR LA LETTRE "W"

+LESS THAN 0.5 PERCENT BUT NOT ZERO / INFERIEURE A 0.5 POURCENT MAIS SUPERIEURE A ZERO

TABLE/TABLEAU 5

WIND VENT

MAY 1978 MAI

STATION	HOURS HEURES	PREVAILING DIRECTION / MEAN SPEED / DIRECTION DOMINANTE / VITESSE MOYENNE km/h		MAXIMUM HOURLY WIND / VENT MAXIMAL HORAIRE: SPEED VITESSE km/h	DIRECTION	DATE	PEAK SPEED / VITESSE DE POINTE: SPEED VITESSE km/h	DIRECTION	DATE
BRITISH COLUMBIA COLOMBIE-BRITANNIQUE									
DRYAD POINT	705	NW	9.1	37	SE	01	M		
DUNCAN LAKE DAM	715	SW	10.3	40	W	12‡	M		
EGG ISLAND	744	SW	16.1	61	SE	27‡	M		
ENTRANCE ISLAND	744	NW	20.4	63	E	13	M		
ESTEVAN POINT	744	NW	26.3	87	WNW	20	107	SE	13
ETHELDA BAY	744	W	9.8	37	SE	01	M		
FORT NELSON A	744	NNW	8.6	32	NNW	12	56	W	02‡
FORT ST JOHN A	744	WSW	12.1	43	WSW	27	69	W	27
GERMANSEN LANDING	744	NW	5.0	18	NW	02	M		
HOPE A	739	W	11.8	37	W	21	63	W	02‡
KAMLOOPS A	744	WNW	10.7	43	NW	24‡	69	WSW	27
KITIMAT TOWNSITE	668	SW	9.9	26	SW	08‡	M		
LAWYER ISLAND	744	SE	12.3	60	SE	01	M		
LEONARD ISLAND	730	NW	17.0	48	NW	20‡	M		
MACKENZIE A	740	S	6.3	32	W	17	70	S	27
MORRES ISLAND	744	NW	11.3	46	S	01	M		
MERRY ISLAND	744	NW	18.3	56	E	13‡	M		
MULE CREEK	702	SE	18.6	48	SE	01‡	M		
NANAIMO DEPARTURE BAY	729	NW	11.3	32	E	13	M		
PENTICTON A	744	N	12.2	44	S	14	65	N	29
PINE ISLAND	744	SE	16.3	48	SE	27	M		

SPEED CLASSES (%) / CLASSES DE VITESSE (%) km/h

CALM CALME	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61
2	36	31	26	4	1			
8	26	32	21	8	4	1		
+	10	28	23	18	13	7	1	
+	11	16	24	20	23	5	1	
6	4	17	14	20	19	11	6	3
1	27	38	29	4	1			
23	10	37	24	6	+			
4	8	48	26	14	2	+		
3	62	33	2					
9	13	32	28	17	1			
32	5	21	21	16	4	1		
5	21	45	24	5				
+	19	40	27	9	4	1	+	
+	18	20	25	21	12	4		
32	15	36	16	1	+			
+	20	43	24	10	3	+		
	10	30	26	12	12	8	2	
+	9	14	35	28	12	2		
7	19	27	36	11	+			
17	4	32	28	13	5	1		
3	16	20	30	16	10	3		

AVERAGE SPEED IN km/h / PERCENTAGE FREQUENCY OF DIRECTION — VITESSE MOYENNE EN km/h / FREQUENCE DE LA DIRECTION EN POURCENTAGE

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
7.7 13		3.9 1		7.0 5		11.8 19		10.9 18		7.1 15		2.7 4		10.8 23	
8.0 2		12.3 20		8.9 20		8.0 +		12.8 1		16.2 26		7.8 21		5.4 2	
3.0 +		0		8.3 7		20.5 32		12.5 8		20.5 38		14.5 15		28.0 +	
10.2 3		7.3 3		19.6 9		20.6 22		10.5 8		19.7 4		15.9 17		27.4 34	
10.6 2	4.8 1	6.6 1	8.6 1	11.7 4	23.4 8	31.6 8	31.1 4	24.6 3	17.3 3	16.9 2	15.1 1	17.6 4	29.7 15	34.8 31	16.8 6
4.9 10		5.5 6		4.8 8		11.7 10		13.0 21		12.8 10		10.2 22		10.2 10	
11.8 10	11.6 3	7.8 1	8.6 1	6.4 2	7.2 2	9.3 5	8.4 5	7.8 7	9.2 6	13.0 2	12.3 3	12.4 7	10.7 3	14.1 7	14.0 13
12.7 11	8.9 3	7.2 1	8.3 2	7.4 2	8.5 3	7.2 2	7.8 3	8.4 4	8.8 3	15.1 10	15.1 24	14.7 18	8.9 3	7.4 2	12.7 5
4.7 4		3.8 5		3.8 11		5.1 8		4.7 3		4.5 15		3.8 17		6.9 34	
2.0 +	4.0 +	6.3 +	9.3 6	12.4 16	7.8 2	8.3 1	8.0 1	5.9 4	6.0 4	5.5 6	7.9 6	16.4 22	17.8 19	17.3 4	3.0 +
13.7 1	12.6 1	13.2 1	9.6 1	10.7 6	14.0 9	16.6 10	8.9 2	8.5 2	14.6 1	17.5 3	17.8 4	15.9 10	20.4 11	17.5 4	30.3 2
5.0 4		7.4 12		3.8 4		9.7 11		9.5 26		12.6 37		3.7 1		11.0 +	
6.1 5		5.8 1		8.5 6		16.5 42		12.4 5		8.7 8		7.3 6		10.1 26	
8.9 8		4.3 5		5.7 9		20.0 17		20.4 8		14.2 4		12.1 7		21.7 42	
9.5 8	7.8 3	7.2 1	6.9 2	7.3 4	5.6 1	5.3 3	7.6 7	9.6 12	11.2 6	9.7 3	10.9 5	13.0 6	11.0 3	6.4 2	9.3 2
7.8 8		9.1 4		8.4 9		7.6 10		15.9 19		13.2 15		10.0 9		11.9 26	
8.0 4		12.2 1		27.3 24		26.8 14		11.1 4		12.8 7		11.5 10		14.5 36	
11.6 2		5.0 1		13.4 8		20.8 46		18.4 31		8.9 1		4.7 2		19.1 8	
9.2 6		9.9 3		12.0 11		12.4 14		10.9 4		6.9 2		9.9 24		15.1 29	
12.9 30	14.1 9	11.8 2	7.6 1	10.9 1	12.3 +	6.3 1	14.1 2	21.9 18	17.7 1	8.5 1	12.0 1	13.3 1	12.0 1	12.7 4	11.5 10
3.0 2		2.4 1		2.6 1		16.0 35		10.2 2		9.1 3		15.2 19		18.2 34	

‡FIRST OF SEVERAL / PREMIERE DE PLUSIEURS

ON INDIQUE UN VENT D'OUEST PAR LA LETTRE "W"

+LESS THAN 0.5 PERCENT BUT NOT ZERO / INFERIEURE A 0.5 POURCENT MAIS SUPERIEURE A ZERO

WIND VENT

STATION	HOURS / HEURES	PREVAILING DIRECTION / MEAN SPEED / DIRECTION DOMINANTE / VITESSE MOYENNE km/h		MAXIMUM HOURLY WIND / VENT MAXIMAL HORAIRE: SPEED VITESSE km/h	DIRECTION	DATE	PEAK SPEED / VITESSE DE POINTE: SPEED VITESSE km/h	DIRECTION	DATE
BRITISH COLUMBIA / COLOMBIE-BRITANNIQUE									
DUNCAN LAKE DAM	153	M	M	M			M		
EGG ISLAND	720	SW	18.2	56	W	18	M		
ENTRANCE ISLAND	466	M	M	M			M		
ESTEVAN POINT	720	NW	18.8	63	NNW	18	76	SSE	12
ETHELDA BAY	720	NW	9.4	23	NW	18‡	M		
FORT NELSON A	720	NNW	7.1	37	W	17	65	SW	17
FORT ST JOHN A	720	WSW	13.7	46	WSW	17	61	W	17
GERMANSEN LANDING	720	NW	5.7	19	NW	17	M		
HOPE A	720	WNW	11.6	35	W	14‡	58	WNW	09
HUDSON HOPE BCHPA DAM	702	W	9.5	43	W	17	M		
KAMLOOPS A	720	SE	8.3	44	SW	17	67	S	12
KITIMAT TOWNSITE	645	S	12.8	35	S	17	M		
LAWYER ISLAND	720	NW	10.4	31	NW	17	M		
LENNARD ISLAND	670	NW	11.8	42	S	11‡	M		
MACKENZIE A	700	S	7.5	30	NNE	17	50	NNE	17
MCINNES ISLAND	720	NW	8.9	43	NW	17	M		
MERRY ISLAND	720	NW	15.0	48	E	11	M		
MULE CREEK	717	SE	17.6	43	SE	23	M		
NANAIMO DEPARTURE BAY	708	NW	10.2	27	NW	05‡	M		
PENTICTON A	720	N	8.3	41	S	29	50	S	29
PINE ISLAND	720	NW	14.3	46	NW	17	M		

SPEED CLASSES (%) / CLASSES DE VITESSE (%) km/h

CALM / CALME	1-6	6-11	12-19	20-28	29-38	39-49	50-61	>61
M	M	M	M	M	M	M	M	M
+	11	27	24	17	15	5	1	
M	M	M	M	M	M	M	M	M
9	6	23	18	22	13	6	3	+
2	23	46	27	2				
29	13	37	16	5	+			
8	12	29	26	20	5	+		
3	52	40	5					
13	12	27	30	17	1			
7	34	31	13	10	4	1		
38	9	21	19	9	3	+		
	14	35	42	8	1			
2	23	42	23	9	1			
8	22	25	27	11	6	1		
29	9	38	20	4	+			
+	16	59	18	4	1	+		
+	14	35	25	14	10	2		
	13	16	32	26	12	1		
7	22	31	32	8				
21	11	44	<18	5	1	+		
1	19	23	29	22	4	2		

AVERAGE SPEED IN km/h / PERCENTAGE FREQUENCY OF DIRECTION — VITESSE MOYENNE EN km/h / FREQUENCE DE LA DIRECTION EN POURCENTAGE

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M
0		0		9.7 6		13.4 10		7.2 7		22.4 56		14.8 18		12.0 +	
M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M
7.2 3	5.5 +	9.3 +	6.1 1	11.9 2	10.8 5	24.1 13	22.1 8	14.1 5	11.0 3	11.4 3	13.2 2	8.9 2	17.0 8	27.9 26	20.3 8
7.1 10		8.4 4		4.8 4		8.3 6		8.2 12		8.0 3		9.0 24		12.5 35	
12.3 8	9.9 2	8.9 2	7.7 3	7.5 2	8.3 1	8.3 4	7.1 3	8.9 7	7.0 4	8.4 3	8.1 3	12.4 6	12.8 6	12.9 8	11.7 11
17.8 10	14.7 3	14.7 1	9.3 1	9.6 1	10.9 2	11.1 4	9.8 5	8.0 5	10.8 4	13.5 13	18.3 19	18.0 16	14.0 3	11.4 2	13.2 3
3.6 3		4.7 3		4.3 7		4.8 9		3.7 3		6.1 12		3.5 17		7.6 43	
2.0 +	0	8.0 1	11.4 5	12.3 14	5.4 2	3.0 1	7.3 +	4.6 1	5.5 6	6.1 6	7.3 4	16.4 16	17.4 25	16.7 6	2.6 +
6.1 6		6.1 20		8.4 13		8.3 5		3.5 .		13.5 9		15.9 22		10.4 15	
11.8 1	15.0 +	8.3 +	14.8 1	12.3 6	13.4 9	13.6 10	8.3 3	9.4 3	11.9 2	13.8 2	16.7 5	10.4 6	17.9 8	16.3 4	13.2 1
11.3 6		7.4 16		4.5 2		10.8 5		14.6 39		13.3 31		5.8 +		8.5 1	
6.6 5		3.3 1		5.7 3		12.1 16		3.4 2		9.8 17		8.4 14		12.6 40	
5.5 8		3.8 3		4.1 6		16.9 15		18.0 19		13.2 5		11.5 11		13.5 25	
9.4 3	9.1 5	8.1 3	9.2 2	8.1 2	4.7 1	7.3 1	6.2 2	8.3 13	11.0 10	11.6 5	12.6 5	14.3 8	13.4 4	13.2 4	9.3 3
9.9 11		9.3 3		5.8 4		4.8 4		9.3 16		7.9 4		7.4 8		11.4 50	
5.6 5		5.7 1		19.1 19		22.6 24		8.5 4		8.8 5		9.8 13		12.7 29	
6.4 2		6.3 3		14.1 5		20.0 43		18.8 28		14.5 11		8.5 2		16.6 6	
8.5 10		9.4 4		10.7 18		10.2 7		9.4 3		7.2 2		9.9 22		13.8 27	
10.0 27	9.2 11	7.9 1	5.7 2	7.4 2	6.0 +	6.0 1	11.3 5	15.1 10	13.5 1	11.2 1	10.3 1	11.6 1	10.3 2	10.3 3	9.1 11
4.0 3		2.8 1		3.1 2		8.3 18		3.0 +		7.0 1		17.7 31		16.8 42	

‡FIRST OF SEVERAL / PREMIERE DE PLUSIEURS

OR INDIQUE UN VENT D'OUEST PAR LA LETTRE "W"

+LESS THAN 0.5 PERCENT BUT NOT ZERO / INFERIEURE A 0.5 POURCENT MAIS SUPERIEURE A ZERO

TABLE/TABLEAU 5

WIND VENT

JULY 1978 JUILLET

STATION	HOURS HEURES	PREVAILING DIRECTION MEAN SPEED DIRECTION DOMINATE VITESSE MOYENNE km/h		MAXIMUM HOURLY WIND VENT MAXIMAL HORAIRE SPEED VITESSE km/h DIRECTION		DATE	PEAK SPEED VITESSE DE POINTE SPEED VITESSE km/h DIRECTION		DATE
BRITISH COLUMBIA COLOMBIE-BRITANNIQUE									
ESTEVAN POINT	744	NW	20 3	63	NW	09	74	NW	09
ETHELDA BAY	744	NW	8 2	24	NW	20[	M		
FORT NELSON A	744	NNW	5 5	37	NW	16	65	NW	16
FORT ST JOHN A	744	WSW	11 2	43	SW	01	65	SW	01
GERMANSEN LANDING	744	NW	5 0	14	NE	09	M		
HOPE A	744	WNW	12 7	32	W	13[	63	W	27
HUDSON HOPE BCHPA DAM	724	W	8 5	35	W	01	M		
KAMLOOPS A	744	W	9 4	52	ENE	07	76	NE	07
KITIMAT TOWNSITE	716	SW	12 8	28	SW	10	M		
LAWYER ISLAND	744	NW	8 2	27	NW	21	M		
LENNARD ISLAND	744	NW	12 1	37	NW	09[	M		
LUCY ISLAND	736	W	12 6	39	W	20	M		
MACKENZIE A	731	S	8 6	30	N	27	41	N	27
MCINNES ISLAND	743	NW	6 0	32	NW	20	M		
MERRY ISLAND	744	SE	13 2	40	SE	04[	M		
MICA DAM	730	N	10 5	43	SW	26	M		
MULE CREEK	719	SE	17 0	40	SE	02[	M		
NANAIMO DEPARTURE BAY	703	E	9 5	29	W	23	M		
PENTICTON A	744	N	8 8	30	S	01	46	SSE	01
PINE ISLAND	738	W	13 1	34	W	18	M		
POINT ATKINSON	744	E	12 8	43	E	16	M		

SPEED CLASSES (%) / CLASSES DE VITESSE (%) km/h

CALM CALME	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61
7	6	24	15	16	20	10	2	+
2	31	46	20	1				
29	22	40	7	2	+			
16	17	27	20	16	4	+		
3	60	35	2					
12	11	23	30	22	2			
3	39	35	13	8	2			
26	10	33	17	11	3		+	
+	14	31	45	10	+		+	
1	30	51	15	3				
1	20	33	31	12	3			
+	22	32	28	14	4	+		
28	11	46	14	1	+			
1	34	50	12	3	+			
1	18	37	26	8	8	2		
	26	40	24	9	1	+		
+	9	18	37	28	8	+		
12	22	28	33	5	+			
39	10	40	23	7	+			
1	14	29	40	15	1			
3	29	32	11	12	11	2		

AVERAGE SPEED IN km/h / PERCENTAGE FREQUENCY OF DIRECTION

VITESSE MOYENNE EN km/h / FREQUENCE DE LA DIRECTION EN POURCENTAGE

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
66 1	50 +	60 +	90 +	65 1	184 5	115 4	100 4	88 2	48 1	150 1	64 1	113 6	228 17	289 43	164 6
53 8		37 2		37 4		52 7		67 17		78 8		93 22		114 30	
84 7	93 4	61 2	60 2	59 5	63 3	55 2	59 4	60 6	65 5	60 2	77 4	85 6	96 5	109 5	95 8
114 10	102 6	103 4	96 1	96 3	121 2	115 3	78 3	68 2	75 1	165 11	177 16	159 13	110 3	92 3	93 3
33 4		61 4		37 16		50 11		47 1		50 9		34 19		69 33	
0	0	0	105 3	109 14	79 3	20 +	0	38 1	54 3	60 5	68 4	151 15	188 32	193 7	200 1
58 7		64 15		88 15		77 9		42 1		106 11		103 32		95 7	
95 1	93 1	147 1	141 2	102 10	115 8	119 6	83 3	113 2	121 2	128 3	131 5	157 15	150 10	107 3	78 2
76 7		69 10		45 1		144 9		122 25		149 48		30 +		0	
80 6		37 1		62 4		111 13		47 1		74 15		62 17		91 42	
59 10		42 1		45 1		78 6		137 14		70 4		69 6		147 57	
0		0		56 6		108 7		86 9		43 4		144 74		20 +	
84 7	80 5	82 3	84 4	93 5	65 2	66 3	79 6	92 8	102 6	91 3	112 6	105 8	103 2	87 1	90 3
66 6		0		43 +		26 1		58 13		62 8		59 18		99 53	
47 5		30 +		147 20		205 30		63 7		87 8		98 11		94 18	
121 34		91 3		40 +		78 31		87 10		101 11		65 2		69 9	
59 2		82 1		165 35		206 48		99 10		33 1		41 1		114 2	
121 6		110 5		95 31		89 7		33 1		34 1		114 15		134 22	
108 26	104 9	88 2	66 1	52 1	54 1	60 1	116 5	151 15	116 1	40 +	163 +	66 1	66 1	89 4	97 12
30 1		0		0		52 3		30 +		31 1		153 48		121 46	
30 +		54 11		201 40		140 2		65 3		79 8		98 29		45 4	

§ FIRST OF SEVERAL / PREMIERE DE PLUSIEURS

On indique un vent d'ouest par la lettre "W"

+ LESS THAN 0.5 PERCENT BUT NOT ZERO / INFERIEURE A 0.5 POURCENT MAIS SUPERIEURE A ZERO

TABLE/TABLEAU 5

WIND VENT

AUGUST 1978 AOUT

STATION	HOURS HEURES	PREVAILING DIRECTION / MEAN SPEED / DIRECTION DOMINANTE / VITESSE MOYENNE km/h		MAXIMUM HOURLY WIND / VENT MAXIMAL HORAIRE: SPEED VITESSE km/h	DIRECTION	DATE	PEAK SPEED / VITESSE DE POINTE: SPEED VITESSE km/h	DIRECTION	DATE
BRITISH COLUMBIA COLOMBIE-BRITANNIQUE									
ESTEVAN POINT	744	NW	21.3	82	SE	24	145	SE	24
ETHELDA BAY	744	S	7.9	31	S	05‡	M		
FORT NELSON A	744	N	5.6	32	NNW	25			
FORT ST JOHN A	744	WSW	12.2	43	W	05	65	WSW	05‡
GERMANSEN LANDING	722	W	3.9	14	NE	01‡	M		
HOPE A	744	WNW	10.1	32	WNW	06‡	50	WNW	04‡
HORSEFLY BCFS	700	SW	11.7	48	SW	04	M		
HUDSON HOPE BCHPA DAM	733	W	8.9	38	W	05	M		
KAMLOOPS A	744	E	10.7	46	WNW	30	61	SW	04
KITIMAT TOWNSITE	743	SW	11.1	29	SW	03‡	M		
LAWYER ISLAND	744	SE	10.9	42	SE	05	M		
LEONARD ISLAND	744	NW	15.4	61	SE	24	M		
LUCY ISLAND	407	M	M	M			M		
MACKENZIE A	717	S	6.1	26	S	05‡	44	S	04
MORRIES ISLAND	744	S	10.0	43	S	06	M		
MERRY ISLAND	744	E	19.3	63	E	23	M		
MICA DAM	744	SE	10.8	35	SW	18	M		
MULE CREEK	687	E	15.2	37	W	24‡	M		
NANAIMO DEPARTURE BAY	732	E	8.3	26	NW	06‡	M		
PENTICTON A	744	N	8.0	28	W	10	52	W	10
PINE ISLAND	744	SE	11.5	40	SE	11‡	M		

SPEED CLASSES (%) / CLASSES DE VITESSE (%) km/h

CALM CALME	1-5	6-11	12-19	20-28	29-38	39-49	50-61	61+
10	6	18	18	18	14	9	5	2
1	35	46	15	2	1			
33	16	39	10	2	+			
15	12	26	27	15	4	1		
4	74	21	1					
16	14	31	25	13	1			
7	21	28	29	9	5	1		
+	43	34	14	7	2	+		
17	10	34	26	11	2	+		
1	22	38	28	11	+			
1	24	37	26	10	2	+		
2	19	25	25	18	6	4	1	
M	M	M	M	M	M	M	M	M
32	16	37	14	1				
+	26	46	19	6	3	+		
+	13	26	25	13	9	10	4	+
+	21	44	26	7	2			
1	16	21	35	18	9			
16	27	26	27	4				
21	14	41	18	6				
4	21	33	31	8	3	+		

AVERAGE SPEED IN km/h / PERCENTAGE FREQUENCY OF DIRECTION — VITESSE MOYENNE EN km/h / FREQUENCE DE LA DIRECTION EN POURCENTAGE

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
7.5 1	4.0 +	4.5 +	4.0 +	12.7 1	22.6 14	30.2 19	18.8 6	12.1 1	10.7 1	8.0 1	7.4 1	9.7 5	16.4 6	29.8 26	16.1 6
5.4 7		5.8 11		5.2 14		8.9 18		9.8 24		11.7 7		7.3 10		8.2 8	
9.8 10	8.9 5	7.0 3	8.9 2	7.4 2	5.9 1	6.0 3	6.6 3	6.0 4	6.9 7	7.9 3	7.8 4	10.3 5	8.3 3	10.6 3	10.8 5
17.1 14	11.9 1	9.0 +	5.8 1	5.5 1	11.5 2	8.9 7	7.7 3	9.1 4	10.1 5	13.4 12	17.5 21	18.2 9	11.1 1	10.4 1	17.3 3
3.0 3		5.2 5		3.9 16		4.9 10		3.2 7		3.7 11		3.1 24		5.1 20	
0 0	0	4.0 1	11.6 3	10.2 12	7.1 4	10.6 1	8.7 1	3.9 2	6.0 6	5.7 6	6.3 6	14.9 17	17.7 20	16.4 4	14.3 +
11.6 22		11.4 14		18.2 4		16.4 9		14.2 8		10.0 27		16.4 2		17.8 7	
6.9 8		10.3 13		7.5 8		8.8 5		4.3 3		10.9 12		9.2 43		8.2 8	
5.7 1	7.4 1	8.0 1	10.7 3	10.9 17	13.6 15	11.8 8	9.7 3	12.3 3	13.9 2	18.3 3	13.6 5	14.0 12	15.4 8	12.9 1	9.5 +
7.6 9		10.0 14		4.9 1		13.5 15		9.4 24		13.4 34		2.6 1		4.4 1	
6.4 9		4.8 3		7.0 6		15.5 47		6.2 1		7.2 8		6.5 10		7.8 15	
7.7 9		4.7 2		4.1 6		24.0 22		16.9 19		6.9 3		7.5 3		15.9 34	
M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M
7.3 5	7.1 4	8.0 2	12.5 1	9.7 4	6.6 2	6.4 3	8.1 14	9.4 16	10.8 4	11.6 2	7.4 3	8.3 3	6.2 1	7.3 +	11.3 1
6.3 6		14.9 4		8.1 14		5.8 8		12.1 38		9.9 10		6.7 7		11.0 13	
4.2 3		3.9 2		24.9 34		23.3 33		6.8 6		12.7 3		12.3 4		11.1 15	
13.5 17		10.8 1		3.6 1		9.7 44		8.2 15		16.8 15		5.0 1		6.5 8	
7.8 3		8.8 1		16.9 53		15.5 2		8.0 22		2.0 +		20.8 15		18.9 3	
7.0 4		9.9 6		9.3 27		11.6 19		4.8 5		2.4 2		9.5 10		13.8 11	
8.7 25	8.4 10	7.4 4	7.7 1	6.6 2	6.6 1	7.6 1	11.4 4	15.9 15	15.7 2	10.3 +	14.0 1	11.4 2	8.7 +	6.8 2	8.2 9
6.6 3		4.5 1		6.8 2		12.6 52		3.3 +		5.0 2		11.9 17		12.6 20	

‡ FIRST OF SEVERAL / PREMIERE DE PLUSIEURS

ON INDIQUE UN VENT D'OUEST PAR LA LETTRE 'W'

+ LESS THAN 0.5 PERCENT BUT NOT ZERO / INFERIEURE A 0.5 POURCENT MAIS SUPERIEURE A ZERO

TABLE/TABLEAU 5

WIND VENT

SEPTEMBER 1978 SEPTEMBRE

STATION	HOURS HEURES	PREVAILING DIRECTION / MEAN SPEED / DIRECTION DOMINANTE / VITESSE MOYENNE km/h		MAXIMUM HOURLY WIND / VENT MAXIMAL HORAIRE SPEED VITESSE km/h	DIRECTION	DATE	PEAK SPEED / VITESSE DE POINTE SPEED VITESSE km/h	DIRECTION	DATE
BRITISH COLUMBIA COLOMBIE-BRITANNIQUE									
ENTRANCE ISLAND	720	SE	18.2	45	SE	09	M		
ESTEVAN POINT	720	SE	21.9	63	ESE	09	133	SE	09
ETHELDA BAY	720	SE	10.9	32	S	19	M		
FORT NELSON A	720	SSW	4.8	28	SSW	29	46	N	17
FORT ST JOHN A	720	WSW	11.1	37	WSW	20‡	52	W	29
GIRMAMEEN LANDING	715	W	3.3	16	W	15	M		
HOPE A	720	E	8.7	32	WNW	15‡	67	W	15
HORSEFLY BCFS	673	SW	11.6	40	SE	08‡	M		
HUDSON HOPE BCHPA DAM	681	W	8.1	34	W	29	M		
KAMLOOPS A	720	ESE	11.8	46	SW	30‡	72	SW	30
KITIMAT TOWNSITE	713	NE	9.1	35	NE	26	M		
LAWYER ISLAND	716	SE	14.7	55	SE	19	M		
LEMIARD ISLAND	720	SE	16.0	61	SE	09	M		
LUCY ISLAND	720	SE	20.8	89	SE	19‡	M		
MACKENZIE A	703	SSE	5.1	22	S	01‡	44	S	29
MCINNES ISLAND	720	S	12.7	40	S	14	M		
MERRY ISLAND	720	SE	19.7	63	SE	21	M		
MICA DAM	716	SE	10.4	32	SW	08	M		
MULE CREEK	679	E	14.5	39	E	13‡	M		
NANAIMO DEPARTURE BAY	678	SE	8.5	26	SE	09‡	M		
PENTICTON A	720	N	9.1	32	S	01‡	52	S	08

SPEED CLASSES (%) / CLASSES DE VITESSE (%) km/h

CALM CALME	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61
-	11	22	25	24	14	4		
5	5	21	19	20	13	12	4	1
-	20	41	30	8	1			
38	20	32	8	2				
16	16	28	22	14	4			
8	80	11	1					
18	18	32	21	10	-			
20	7	32	20	12	8	1		
-	44	37	12	6	1			
18	9	27	26	15	4	1		
-	31	42	21	5	1			
3	14	26	35	12	7	2	1	
1	19	24	22	19	13	2	+	
-	16	24	16	12	15	12	3	2
33	23	33	10	1				
-	16	40	27	12	5	+		
-	12	26	21	13	16	10	2	+
-	22	47	22	8	1			
1	16	26	33	17	7	+		
8	31	31	25	5				
18	15	38	19	9	1			

AVERAGE SPEED IN km/h / PERCENTAGE FREQUENCY OF DIRECTION — VITESSE MOYENNE EN km/h / FREQUENCE DE LA DIRECTION EN POURCENTAGE

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
11.3 3		9.6 1		16.6 10		21.1 41		12.2 10		17.3 3		11.4 14		23.2 18	
11.0 3	5.5 +	5.3 +	9.4 2	12.9 7	21.4 15	29.7 25	29.7 11	21.4 5	18.4 3	26.2 2	11.1 1	18.0 2	25.2 3	27.3 9	16.7 7
6.9 8		8.1 14		6.8 13		13.6 25		14.3 21		11.7 6		10.3 8		10.2 4	
8.0 6	7.1 3	6.4 2	4.7 1	6.3 3	7.4 1	5.9 5	5.6 4	5.7 5	6.4 7	6.2 3	6.0 3	8.3 4	13.5 4	11.5 5	9.5 6
10.0 3	7.7 1	9.0 1	8.8 1	10.9 4	8.9 4	8.6 6	8.0 5	9.0 6	9.3 8	14.6 14	17.5 15	19.6 9	11.8 3	10.4 3	19.3 4
3.1 3		2.8 2		3.4 13		4.5 13		2.7 9		3.2 12		3.1 28		5.4 12	
4.0 +	2.0 +	5.8 1	9.7 4	10.0 22	8.8 7	12.0 1	4.0 +	5.2 2	5.2 5	5.5 5	6.0 6	13.7 13	16.1 13	15.6 3	10.5 +
10.7 10		11.9 6		21.0 8		16.3 12		17.4 11		9.4 20		12.0 3		20.3 10	
5.5 4		5.9 5		8.4 7		7.9 4		5.2 2		9.2 22		8.1 47		8.9 9	
5.3 1	11.8 1	7.0 +	9.3 2	12.3 14	17.4 20	13.5 7	11.6 3	12.7 4	13.2 2	17.6 3	13.2 4	15.3 13	16.2 5	16.4 1	8.9 2
10.0 14		10.3 26		4.5 3		10.6 12		7.3 23		9.6 19		4.2 1		8.9 1	
5.2 3		11.1 1		9.3 7		18.3 67		4.9 1		10.2 7		5.5 3		7.1 8	
8.6 6		5.2 3		5.0 13		20.7 31		21.0 23		11.5 4		13.9 5		15.7 14	
12.3 15		7.2 4		8.3 5		31.2 46		16.2 11		7.1 4		13.0 10		11.2 5	
8.1 4	6.6 4	6.6 3	5.4 1	5.7 2	4.1 3	5.4 6	7.9 19	9.2 12	6.2 3	10.5 2	8.7 2	6.9 2	5.8 1	6.5 2	5.8 1
7.5 5		13.1 6		8.9 16		13.1 21		15.3 28		15.6 9		10.6 4		11.4 9	
7.4 11		4.4 1		21.0 27		30.3 34		15.8 2		11.0 2		8.1 5		11.3 16	
12.1 10		9.3 2		4.5 +		9.2 44		8.0 16		16.2 19		4.9 2		8.2 5	
5.1 2		7.3 1		17.1 67		16.8 3		8.6 16		0		7.7 7		18.0 1	
5.8 2		5.8 3		7.8 17		12.1 25		8.2 9		9.4 3		6.8 23		12.6 10	
9.3 21	8.8 10	7.4 4	7.6 2	4.8 1	6.6 1	8.1 2	15.0 6	18.1 16	15.2 2	7.8 1	5.6 1	9.6 1	6.3 2	6.1 3	7.8 10

‡ FIRST OF SEVERAL / PREMIERE DE PLUSIEURS

ON INDIQUE UN VENT D'OUEST PAR LA LETTRE 'W'

+ LESS THAN 0.5 PERCENT BUT NOT ZERO / INFERIEURE A 0.5 POURCENT MAIS SUPERIEURE A ZERO

TABLE/TABLEAU 5

WIND VENT

OCTOBER 1978 OCTOBRE

STATION	HOURS / HEURES	PREVAILING DIRECTION / MEAN SPEED / DIRECTION DOMINANTE / VITESSE MOYENNE km/h			MAXIMUM HOURLY WIND / VENT MAXIMAL HORAIRE			PEAK SPEED / VITESSE DE POINTE			SPEED CLASSES (%) / CLASSES DE VITESSE (%) km/h									AVERAGE SPEED IN km/h / PERCENTAGE FREQUENCY OF DIRECTION / VITESSE MOYENNE EN km/h / FREQUENCE DE LA DIRECTION EN POURCENTAGE													
					SPEED VITESSE km/h	DIRECTION	DATE	SPEED VITESSE km/h	DIRECTION	DATE	CALM CALME	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
BRITISH COLUMBIA / COLOMBIE-BRITANNIQUE																																	
ENTRANCE ISLAND	744	NW	17.5	53	NW	23	M				+	12	24	26	24	9	4	1		9.1 4		9.4 1		14.4 4		20.1 25		9.3 7		10.6 1		13.7 21		21.3 37	
ESTEVAN POINT	744	SE	20.5	76	NW	23	01	NW	23		0	7	22	18	16	12	11	4	1	12.1 7	6.7 1	8.0 1	8.6 2	10.3 6	20.9 12	28.2 21	14.7 3	12.3 2	32.7 1	31.6 1	10.2 1	17.5 1	27.1 5	33.5 17	16.9 10
ETHELDA BAY	744	S	11.2	47	S	31	M				+	33	30	23	9	3	2			4.8 7		5.1 12		4.8 15		13.4 19		16.5 28		15.5 9		9.1 7		9.6 3	
PORT NELSON A	744	SSW	6.8	37	SW	31	05	SW	31		25	17	41	12	4	1				6.4 6	7.1 4	6.7 2	5.2 1	5.0 +	6.2 1	6.3 2	7.1 3	7.8 11	7.7 14	9.5 6	9.9 5	12.5 6	11.5 2	12.9 4	12.5 7
PORT ST JOHN A	744	WSW	10.4	57	WSW	30	03	SW	31		3	6	18	24	33	12	2	2		10.9 3	9.6 2	8.1 1	5.0 +	4.0 +	10.4 1	10.5 1	8.3 2	11.8 4	16.3 7	21.4 10	23.5 40	22.5 14	13.4 1	12.5 1	6.4 1
GERMANSEN LANDING	726	W	4.1	16	SE	31	M				4	74	19	3						3.3 3		4.7 1		3.5 7		9.0 10		3.4 5		4.2 18		3.3 33		6.4 18	
HOPE A	736	E	11.3	41	W	23	02	W	10		12	16	27	28	15	2	+			.0	.0	8.0 +	13.1 7	13.7 33	11.5 9	9.9 3	7.5 1	8.0 2	5.5 4	6.5 5	8.0 4	15.7 9	19.7 10	13.0 1	10.0 +
HORSEFLY BCFS	712	N	9.7	46	SW	09	M				44	3	23	14	9	6	1			10.2 13		13.6 9		16.9 3		22.6 6		20.7 5		12.0 14		24.5 4		22.2 2	
HUDSON HOPE BCHPA DAM	705	W	14.9	60	SW	31	M					22	27	16	23	9	1	+		6.2 2		6.0 2		6.7 2		6.5 1		7.1 2		17.0 30		15.5 56		6.5 6	
KAMLOOPS A	744	ESE	10.3	44	W	20	76	SW	10		22	10	34	20	9	4	1			13.5 1	7.0 1	5.5 1	9.0 2	11.6 10	14.2 22	14.9 12	12.6 2	11.5 1	15.0 1	11.5 2	11.9 3	14.9 5	16.5 4	11.0 1	12.0 1
KITIMAT TOWNSITE	739	SE	10.2	32	SE	30	M				+	28	35	31	5	1				6.9 16		5.2 7		3.3 1		12.9 63		4.3 3		4.6 6		3.3 1		6.4 9	
LAWYER ISLAND	744	SE	18.3	50	SE	02	M				1	6	17	42	16	11	4	1		8.9 3		10.5 1		11.2 7		21.3 69		10.5 1		15.5 9		9.2 6		11.3 3	
LEMIARD ISLAND	744	SVL	13.3	47	S	06	M				2	26	33	13	14	9	3			9.3 10		5.5 4		5.2 21		18.5 22		16.1 12		16.5 3		9.1 3		16.2 25	
LUCY ISLAND	744	SE	25.5	79	SE	02	M				+	9	20	17	16	17	10	6	5	11.0 4		9.4 1		7.5 4		32.5 46		30.0 21		12.5 7		16.0 11		12.0 6	
MACKENZIE A	737	SSE	8.5	43	SSE	31	46	SSW	10		25	10	36	22	5	2	+			5.5 1	5.0 1	6.0 +	5.0 +	5.3 1	7.5 2	9.5 6	12.1 28	13.4 24	9.5 2	10.5 2	13.5 2	14.1 3	13.3 1	10.5 1	7.0 1
MORRIES ISLAND	744	S	13.5	60	S	31	M				+	24	40	16	10	4	3	3	+	7.1 9		7.2 4		7.4 16		13.0 14		19.5 31		17.5 11		10.3 5		10.1 10	
MERRY ISLAND	744	NW	14.1	61	SE	23	M				+	19	36	21	10	7	4	1		7.2 22		4.7 +		10.5 14		23.2 19		8.5 1		5.0 2		8.0 5		12.7 37	
MICA DAM	742	SE	12.5	43	SW	10	M					12	40	37	9	1	1			12.1 1		7.0 +		6.3 1		11.3 47		11.5 36		10.5 13		4.0 +		8.4 2	
MULE CREEK	744	E	16.7	47	E	07	M				+	4	19	51	18	6	2			9.5 1		17.0 +		17.3 66		17.3 15		14.2 16		10.0 +		6.3 1		38.5 1	
NANAIMO DEPARTURE BAY	727	W	7.2	27	SE	10	M				12	34	33	19	2					6.1 5		4.4 3		7.5 10		9.9 12		6.1 9		4.0 2		7.4 28		11.4 19	
PENTICTON A	744	N	9.1	46	S	23	03	N	24		21	12	36	17	9	1	1			9.9 29	7.9 9	7.7 2	6.5 1	8.4 1	5.5 1	10.8 2	16.0 7	19.3 12	17.9 2	7.0 +	5.2 1	4.5 1	8.0 1	7.2 2	10.3 6

1 FIRST OF SEVERAL / PREMIERE DE PLUSIEURS

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WIND VENT

STATION	HOURS / HEURES	PREVAILING DIRECTION / MEAN SPEED / DIRECTION DOMINANTE / VITESSE MOYENNE km/h			MAXIMUM HOURLY WIND / VENT MAXIMAL HORAIRE SPEED / VITESSE km/h	DIRECTION	DATE	PEAK SPEED / VITESSE DE POINTE SPEED / VITESSE km/h	DIRECTION	DATE
BRITISH COLUMBIA / COLOMBIE-BRITANNIQUE										
ENTRANCE ISLAND	720	SE	20.3	80	NW	05	M			
ESTEVAN POINT	730	SE	19.6	74	NW	04	115	NW	04
ETHELDA BAY	720	NE	14.4	48	NE	10	M			
FORT NELSON A	720	SSW	4.8	32	W	02	48	NNW	09
FORT ST JOHN A	720	WSW	14.3	56	WSW	021	89	WSW	02
GERMANSEN LANDING	720	W	3.5	16	SE	151	M			
HOPE A	720	E	12.8	48	W	08	70	W	08
HORSEFLY BCPS	688	SW	6.8	48	NW	071	M			
HUDSON HOPE BCHPA DAM	711	W	12.4	56	SW	01	M			
KAMLOOPS A	720	SE	13.0	80	SE	07	74	WNW	17
KITIMAT TOWNSITE	708	N	14.8	51	N	10	M			
LAWYER ISLAND	720	SE	10.9	08	SW	01	M			
LEONARD ISLAND	720	SE	13.6	53	SE	08	M			
LUCY ISLAND	710	SE	27.4	68	S	01	M			
MACKENZIE A	720	SSE	6.3	30	S	011	80	NE	08
MORRIES ISLAND	720	S	17.9	68	S	01	M			
MERRY ISLAND	712	E	16.6	80	SE	08	M			
MICA DAM	676	SE	15.4	60	N	17	M			
MULE CREEK	694	E	10.6	68	W	16	M			
NANAIMO DEPARTURE BAY	716	W	7.9	38	E	10	M			
NOOTKA LIGHTSTATION	714	N	16.2	56	SE	082	M			

SPEED CLASSES (%) / CLASSES DE VITESSE (%) km/h

CALM / CALME	1-5	6-11	12-19	20-29	30-39	40-49	50-61	>61
+	6	26	21	19	16	11	+	
6	5	23	22	17	13	8	3	1
+	16	31	25	17	7	2		
43	15	32	6	2	+			
13	4	32	22	20	6	2	1	
14	70	14	2					
15	9	25	26	17	6	+		
31	22	21	12	6	6	2		
1	21	36	34	11	3	2	+	
25	5	22	25	11	6	3	1	
+	16	29	29	13	7	4	+	
	9	16	34	23	13	3	1	
+	17	36	22	13	6	1	1	
	6	16	16	19	16	14	6	6
16	15	41	21	4	1			
+	12	34	29	16	11	6	2	
	14	36	21	9	6	7	6	
	6	27	29	14	9	1	+	
+	16	17	34	17	12	6	4	+
7	34	26	16	4				
4	16	34	30	16	6	6	1	

AVERAGE SPEED IN km/h / PERCENTAGE FREQUENCY OF DIRECTION

VITESSE MOYENNE EN km/h / FREQUENCE DE LA DIRECTION EN POURCENTAGE

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
13.9 1		25.7 2		23.7 14		24.1 29		11.1 12		6.3 2		15.0 23		25.6 17	
14.6 5	19.2 3	13.4 3	16.8 3	10.9 12	19.8 19	29.4 19	19.8 3	21.8 2	22.8 1	26.0 1	21.1 1	13.8 1	35.2 2	31.9 9	19.8 8
7.7 15		17.6 22		7.2 11		14.7 19		20.6 10		17.7 8		8.8 4		6.3 2	
11.8 7	12.2 3	13.5 +	7.5 +	5.8 1	6.7 1	5.8 2	5.3 2	6.3 8	6.8 8	7.9 6	10.8 3	8.3 2	6.3 2	8.0 4	9.8 8
16.4 16	8.1 1	9.2 1	11.0 +	9.2 1	10.5 6	10.0 6	6.8 1	9.3 6	14.9 5	16.8 12	24.4 16	15.4 10	7.8 1	7.5 1	16.1 6
3.9 1		5.2 1		4.4 11		6.2 15		2.8 3		3.6 20		3.0 27		5.1 6	
.0	0.9 +	9.3 1	16.0 7	14.0 33	17.3 16	20.7 6	5.2 1	7.2 1	7.5 2	7.4 3	7.8 4	17.0 6	22.3 5	16.6 +	.8
6.8 6		9.2 4		15.4 3		19.3 12		9.7 6		9.6 25		14.6 6		22.6 5	
7.8 1		13.7 4		13.5 4		16.2 13		4.6 1		16.3 19		10.1 40		12.5 17	
6.8 +	.8	4.8 +	5.0 +	9.8 7	14.0 17	19.2 23	12.8 3	4.5 +	6.5 +	8.7 1	11.4 1	16.5 4	33.2 11	19.6 6	13.8 3
16.9 43		9.7 5		2.5 +		13.5 36		7.4 5		5.0 4		2.8 +		12.5 5	
12.7 6		24.8 8		12.8 6		22.8 60		21.2 3		15.7 10		7.7 2		12.8 3	
11.5 7		8.8 3		6.2 20		16.8 41		14.8 12		12.3 3		16.7 1		20.8 13	
21.8 10		16.8 7		14.5 6		27.8 43		30.8 8		14.8 7		13.8 3		17.1 7	
7.3 11	10.2 3	7.8 1	11.8 +	6.3 1	6.7 1	6.8 9	11.3 30	11.3 12	17.1 2	12.8 2	8.8 1	10.5 1	8.8 1	7.4 1	8.8 6
16.8 16		25.1 12		7.8 10		12.7 17		23.5 25		16.4 12		10.3 3		16.3 6	
8.8 28		10.5 7		16.2 38		28.7 16		13.5 1		8.8 3		7.8 1		16.2 21	
24.8 15		17.2 6		8.8 +		11.8 46		16.7 16		22.2 10		8.8 +		28.2 2	
6.7 4		7.7 1		17.3 36		23.8 3		8.8 12		4.3 1		23.8 39		25.7 13	
5.8 1		8.8 2		16.8 8		10.1 23		8.2 12		4.8 3		7.7 36		7.4 19	
13.8 46		16.7 33		8.3 1		34.3 6		21.4 7		8.8 3		16.4 3		8.8 2	

1 POINT OF SEVERAL / PREMIERE DE PLUSIEURS

ON DESIGNE UN VENT D'OUEST PAR LA LETTRE "W"

+ LESS THAN 0.5 PERCENT BUT NOT ZERO / INFERIEURE A 0.5 POURCENT MAIS SUPERIEURE A ZERO

STATION	HOURS HEURES	PREVAILING DIRECTION MEAN SPEED DIRECTION DOMINANTE VITESSE MOYENNE km/h			MAXIMUM HOURLY WIND VENT MAXIMAL HORAIRE SPEED VITESSE km/h	DIRECTION	DATE	PEAK SPEED VITESSE DE POINTE SPEED VITESSE km/h	DIRECTION	DATE
BRITISH COLUMBIA COLOMBIE-BRITANNIQUE										
ENTRANCE ISLAND	742	SE	25.9	66	NW	04	M		
ESTEVAN POINT	744	ESE	20.4	89	SSE	16	137	SE	16
ETHELDA BAY	273	M	M	M			M		
FORT NELSON A	744	SSW	3.4	30	WNW	031	52	WNW	20
FORT ST JOHN A	744	WSW	16.4	52	WSW	03	70	WSW	03
GERMANSEN LANDING	744	W	3.1	28	NW	03	M		
HOPE A	739	E	13.6	61	WNW	22	133	W	22
HORSEFLY BCFS	741	SW	6.3	46	SE	111	M		
HUDSON HOPE BCHFA DAM	700	W	12.5	80	SW	131	M		
KAMLOOPS A	744	SE	11.1	57	SE	132	80	SE	13
KITIMAT TOWNSITE	728	SE	14.7	42	N	16	M		
LAWYER ISLAND	744	SE	22.2	86	SE	13	M		
LENNARD ISLAND	744	SE	16.8	69	S	16	M		
LUCY ISLAND	744	SE	30.2	92	SE	13	M		
MACKENZIE A	744	SSE	7.7	41	NNE	17	52	NNE	17
MORANES ISLAND	735	SVL	19.3	64	S	131	M		
MERRY ISLAND	742	E	23.2	70	SE	16	M		
MICA DAM	725	SE	13.0	40		032	M		
MULE CREEK	727	E	17.2	66	E	131	M		
NANAIMO DEPARTURE BAY	742	W	11.0	35	E	100	M		
NOOTKA LIGHTSTATION	743	N	15.7	69	SE	10	M		

SPEED CLASSES (%) / CLASSES DE VITESSE (%) — km/h

CALM CALME	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61
	4	17	20	16	19	14	6	2
4	3	16	22	17	13	10	10	5
M	M	M	M	M	M	M	M	M
53	17	26	4	1	+			
12	7	25	22	22	9	3	+	
19	67	12	2	+	+			
10	11	38	28	16	6	1	+	
26	25	24	13	4	5	1		
4	22	34	20	13	6	1	+	
26	6	31	19	12	4	2	1	
+	16	21	35	21	5	+		
	3	12	31	29	17	7	1	
+	13	22	24	19	16	6	1	+
	2	16	20	16	16	14	9	8
27	9	42	15	6	1	+		
	6	22	28	20	12	8	1	+
	12	25	19	14	13	10	7	3
+	14	38	34	11	3	+		
2	24	17	21	19	7	7	3	1
3	25	31	31	6	2			
+	6	29	44	16	6	1	+	+

AVERAGE SPEED IN km/h / PERCENTAGE FREQUENCY OF DIRECTION — VITESSE MOYENNE EN km/h / FREQUENCE DE LA DIRECTION EN POURCENTAGE

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
21.2 5		9.3 1		29.9 16		30.2 20		15.7 13		12.9 3		16.6 14		34.6 21	
17.5 7	9.2 1	10.7 3	11.0 5	12.6 10	25.5 23	33.3 11	37.2 2	29.7 1	34.0 +	36.9 1	29.6 1	33.9 3	46.3 4	43.9 13	25.6 11
M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M
6.6 5	6.6 3	5.0 +	4.7 1	5.2 1	6.0 +	6.1 1	5.6 2	5.6 6	5.8 10	7.0 6	5.2 3	16.9 2	14.8 1	11.3 1	10.5 3
16.0 17	11.2 1	8.0 +	8.0 +	10.6 1	11.9 6	11.3 4	8.6 1	7.1 2	17.4 3	19.6 8	23.6 27	17.7 12	7.3 2	10.7 2	9.0 2
2.1 1		5.0 1		3.7 9		4.3 13		2.7 4		3.1 18		2.9 25		7.6 10	
15.0 +	4.0 +	9.3 1	10.7 5	12.0 28	15.0 16	17.2 5	4.0 +	6.4 2	8.0 4	7.3 5	11.3 5	23.1 13	27.3 6	31.5 +	.0
7.7 8		6.6 10		25.8 4		21.0 6		6.0 7		9.3 31		19.3 3		18.4 3	
6.0 1		8.1 3		9.6 3		12.1 6		4.6 1		15.7 19		12.6 51		11.8 13	
12.3 1	10.3 1	5.3 +	7.0 1	11.1 6	13.5 17	16.5 22	12.8 6	13.0 1	4.0 1	.0	9.1 2	10.2 4	19.4 4	24.2 7	14.1 2
17.5 32		6.6 6		6.3 1		14.9 46		3.4 2		6.6 4		9.6 1		18.2 6	
16.6 6		26.9 12		10.9 9		34.1 42		21.5 2		20.0 19		14.6 1		22.5 7	
16.3 7		6.6 3		5.9 17		16.2 39		21.1 7		22.6 2		26.5 2		29.0 23	
31.3 13		11.1 1		13.3 3		37.0 42		36.3 6		13.2 7		26.3 9		23.7 19	
7.1 7	9.7 3	5.0 1	4.5 1	9.2 1	12.6 5	10.7 12	12.0 23	10.8 6	9.6 2	12.6 +	13.4 1	9.1 2	12.5 2	7.5 1	9.0 6
17.7 16		19.3 6		8.9 13		11.3 14		39.6 16		25.6 14		34.4 4		21.6 11	
10.0 22		12.2 4		29.5 29		36.4 21		12.0 2		11.0 +		10.7 1		21.2 24	
19.0 5	-	11.6 3		4.0 +		9.7 56		11.0 15		19.6 18		.0		26.9 3	
3.2 4		6.5 1		19.1 39		21.7 4		12.2 27		6.5 2		24.7 16		30.1 5	
9.6 1		5.0 1		15.5 7		14.7 25		9.4 15		5.7 1		6.9 34		12.4 12	
14.7 52		17.2 24		4.1 1		25.9 7		16.3 2		17.4 5		12.2 3		10.6 6	

1 FIRST OF SEVERAL / PREMIERE DE PLUSIEURS

ON INDIQUE UN VENT D'OUEST PAR LA LETTRE "W"

+ LESS THAN 0.5 PERCENT BUT NOT ZERO / INFERIEURE A 0.5 POURCENT MAIS SUPERIEURE A ZERO

STATION	HOURS / HEURES	PREVAILING DIRECTION / DIRECTION DOMINANTE	MEAN SPEED / VITESSE MOYENNE km/h	MAXIMUM HOURLY WIND / VENT MAXIMAL HORAIRE SPEED / VITESSE km/h	DIRECTION	DATE	PEAK SPEED / VITESSE DE POINTE SPEED / VITESSE km/h	DIRECTION	DATE
BRITISH COLUMBIA / COLOMBIE-BRITANNIQUE									
ENTRANCE ISLAND	744	NW	16.7	64	NW	21	M		
ESTEVAN POINT	744	SSE	16.8	69	SW	30	109	SE	30
ETHELDA BAY	104	M	M	M			M		
FORT NELSON A	744	SSW	2.8	30	N	28			
FORT ST JOHN A	744	N	10.8	52	WSW	16	74	WSW	17
GERMANSEN LANDING	744	W	1.8	11	SW	SU	M		
HOPE A	744	E	10.1	37	SSE	SU	72	SSE	04
HORSEFLY SCPS	744	SW	4.8	27	E	30	M		
HUDSON HOPE SCHPA DAM	744	W	5.8	47	NW	16	M		
KAMLOOPS A	744	SE	5.7	48	SSE	29	66	SSE	30
KITIMAT TOWNSITE	664	N	10.7	43	N	03	M		
LAWYER ISLAND	744	SE	22.4	94	S	29	M		
LEONARD ISLAND	744	SE	11.7	60	S	30	M		
LUCY ISLAND	741	SE	21.0	80	SE	16	M		
MACKENZIE A	727	SSE	6.5	30	S	30			
MORRIES ISLAND	740	N	15.0	69	S	30	M		
MERRY ISLAND	744	N	14.4	65	SE	30	M		
MICA DAM	739	SE	9.9	40	N	13	M		
MILE CREEK	709	W	16.4	69	E	16	M		
NANAIMO DEPARTURE BAY	744	W	8.2	34	E	28	M		
KOOTKA LIGHTSTATION	739	N	16.4	69	SE	29	M		

SPEED CLASSES (%) / CLASSES DE VITESSE (%) km/h

CALM / CALME	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61
	9	28	25	17	11	7	2	+
12	8	28	21	16	9	6	3	+
M	M	M	M	M	M	M	M	M
24	20	28	9	+				
21	8	27	17	12	3	1	1	
28	60	8						
6	4	16	27	25	12			
20	55	21	5	1				
8	28	40	17	4	2	1		
69	6	24	10	5	2	+		
+	9	29	17	21	21	3		
+	3	16	29	26	19	7	+	+
1	24	27	21	11	5	1	+	
1	16	27	25	7	7	5	6	7
29	12	27	11	1	+			
+	13	27	26	12	10	3	+	
+	19	42	17	6	5	5	4	+
1	21	44	12	6	5	1		
1	21	29	16	14	11	7	+	+
6	29	25	17	5	1			
+	7	23	43	20	5	1	+	

AVERAGE SPEED IN km/h / PERCENTAGE FREQUENCY [1] OF DIRECTION

VITESSE MOYENNE EN km/h / FREQUENCE DE LA DIRECTION EN POURCENTAGE

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
10.1 4		13.5 2		27.9 15		21.8 17		10.5 13		11.5 5		13.5 10		22.4 25	
14.0 7	9.0 2	7.5 2	11.5 5	11.2 11	20.5 10	25.0 16	17.5 2	22.0 1	4.0 +	34.5 +	25.0 +	21.0 1	16.1 3	21.5 7	10.5 12
M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M
7.5 5	5.5 2	5.5 1	5.0 1	4.5 1	5.4 1	5.4 1	4.5 2	4.5 7	6.3 5	5.5 5	5.5 4	4.1 2	6.7 +	10.5 2	5.5 4
12.5 15	5.4 2	5.4 1	5.0 1	7.7 1	5.3 5	5.4 4	7.2 3	5.5 4	11.2 4	12.5 7	21.5 15	14.3 11	5.5 1	7.2 1	5.7 3
2.5 +		5.0 +		2.7 5		5.2 11		2.2 3		2.7 15		2.7 29		5.5 4	
.5	.5	13.0 +	10.5 4	17.7 25	22.7 25	22.5 12	25.0 +	2.5 1	7.4 1	7.5 2	7.5 2	12.5 1	2.5 +	.5	.5
5.7 6		5.5 13		20.5 +		2.5 7		4.5 12		5.5 25		11.5 2		5.5 4	
5.1 6		7.1 17		5.5 10		10.5 10		3.5 1		7.5 7		7.5 24		14.3 22	
5.5 +	11.5 +	.5	4.5 +	5.5 3	11.5 5	14.2 17	15.5 4	14.5 1	22.5 +	.5	5.5 1	7.5 1	5.5 4	11.3 5	5.7 1
23.3 55		7.5 7		3.5 +		12.5 25		3.5 1		2.5 +		.5		20.1 5	
10.5 2		25.3 22		20.7 15		22.7 45		20.1 1		14.2 5		14.5 1		14.5 2	
10.5 5		5.5 5		5.2 25		15.4 25		14.0 14		5.4 1		7.5 1		15.5 11	
14.1 17		10.1 5		7.5 5		25.5 45		15.5 5		11.5 2		14.5 5		15.5 5	
7.7 14	5.5 12	7.4 1	7.5 +	.5	4.5 +	5.5 2	10.5 15	10.5 11	5.2 1	13.2 1	4.5 +	5.5 +	5.5 +	7.5 1	5.5 2
13.5 25		25.2 15		11.5 25		5.5 5		19.1 25		22.1 4		7.7 1		11.5 3	
7.5 24		5.2 2		15.5 15		25.7 15		11.4 2		5.5 +		5.4 2		12.5 25	
14.1 25		5.7 3		.5		7.5 25		7.5 14		4.5 2		5.1 1		5.5 5	
5.7 5		2.5 +		22.4 25		15.1 1		5.4 22		4.1 1		15.5 25		25.5 15	
5.5 5		7.5 1		15.4 5		11.7 15		7.5 11		5.5 4		7.1 40		5.5 5	
15.7 55		17.2 31		5.5 1		24.5 5		10.4 2		5.5 2		5.5 1		7.4 1	

[1] FIRST OF SEVERAL / PREMIERE DE PLUSIEURS

ON INDIQUE UN VENT D'OUEST PAR LA LETTRE "W"

+ LESS THAN 0.5 PERCENT BUT NOT ZERO / INFERIEURE A 0.5 POURCENT MAIS SUPERIEURE A ZERO

WIND VENT

STATION	HOURS / HEURES	PREVAILING DIRECTION / DIRECTION DOMINANTE	MEAN SPEED / VITESSE MOYENNE km/h	MAXIMUM HOURLY WIND / VENT MAXIMAL HORAIRE SPEED / VITESSE km/h	DIRECTION	DATE	PEAK SPEED / VITESSE DE POINTE SPEED / VITESSE km/h	DIRECTION	DATE	SPEED CLASSES (%) / CLASSES DE VITESSE (%) km/h: CALM / CALME	1-5	6-11	12-19	20-29	30-38	39-49	50-61	>61
BRITISH COLUMBIA / COLOMBIE-BRITANNIQUE																		
ENTRANCE ISLAND	672	SE	25.8	64	E	17	M				6	14	18	18	25	14	6	1
ESTEVAN POINT	672	ESE	24.6	89	SSE	28	139	SE	121	5	4	16	24	17	10	13	9	2
ETHELDA BAY	672	NE	14.2	42	NE	12	M			+	16	38	36	17	5	+		
FORT NELSON A	672	NNW	3.9	22	N	08				52	13	27	6	+				
FORT ST JOHN A	672	N	9.4	37	N	07	48	N	082	33	6	33	21	11	2			
GIRNAMBEN LANDING	672	SE	7.7	21	SE	041	M			3	34	47	16	+				
HOPE A	672	E	12.1	46	WNW	131	87	W	13	12	14	28	29	16	3	1		
HORSEFLY BCFS	672	SW	11.9	50	SE	25	M			7	28	30	16	10	7	3	+	
HUDSON HOPE BCHPA DAM	672	E	9.8	24	E	031	M			3	24	37	33	3				
KAMLOOPS A	672	SE	11.6	63	WNW	131	98	WNW	13	30	12	21	12	13	9	3		+
KITIMAT TOWNSITE	397	M	M	M			M			M	M	M	M	M	M	M	M	M
LAWYER ISLAND	672	SE	21.0	49	SE	24	M			+	6	14	31	20	25	4		
LENNARD ISLAND	672	SE	16.7	61	SE	121	M			+	13	25	22	18	13	7	2	
LUCY ISLAND	672	SE	23.8	72	SE	271	M			+	8	23	22	13	10	11	7	2
MACKENZIE A	659	N	8.1	37	ENE	131	78	NE	13	21	16	40	18	8	1			
MCINNES ISLAND	672	E	17.8	56	S	04	M			+	10	22	31	22	12	3	+	
MERRY ISLAND	672	E	28.2	71	SE	131	M				7	17	16	15	16	16	12	4
MICA DAM	672	N	12.7	53	N	14	M			+	25	34	22	10	6	2	1	
MULE CREEK	672	W	43.2	79	W	04	M				2	3	5	7	15	34	30	5
NANAIMO DEPARTURE BAY	671	SE	11.3	42	SE	13	M			5	23	26	31	10	3	+		
NOOTKA LIGHTSTATION	670	N	17.2	61	SE	081	M				8	27	30	17	7	3	2	

AVERAGE SPEED IN km/h / PERCENTAGE FREQUENCY OF DIRECTION — VITESSE MOYENNE EN km/h / FREQUENCE DE LA DIRECTION EN POURCENTAGE

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
6.7 2		15.0 +		34.2 19		29.9 43		16.8 16		12.6 2		16.8 8		21.7 10	
8.8 2	6.0 1	10.5 3	14.1 3	12.6 13	28.5 22	32.2 22	31.1 9	33.0 6	16.0 1	30.0 1	39.2 1	29.7 2	38.2 4	39.9 3	16.0 2
4.7 +		14.1 80		3.5 2		12.7 22		3.3 1		17.5 23		.0		10.5 2	
7.8 13	7.3 2	4.7 +	4.3 1	5.7 1	5.5 +	4.0 1	5.7 1	4.9 2	5.5 3	4.8 1	3.0 +	4.0 1	6.7 1	9.5 6	9.8 15
14.0 45	6.1 4	7.1 2	7.8 2	9.4 4	10.5 7	13.5 1	.0	5.5 +	4.0 +	.0	7.0 +	6.0 +	6.5 1	9.7 1	13.9 6
4.0 +		6.7 4		5.8 22		9.5 62		3.4 3		3.5 2		2.4 4		3.1 1	
2.0 +	.0	5.8 1	9.7 7	12.8 29	15.2 15	17.5 6	9.1 2	7.3 +	9.7 6	7.2 5	7.3 4	21.2 6	21.7 6	18.0 +	.0
9.2 11		7.2 13		25.8 3		23.8 17		9.5 6		9.9 36		17.3 3		12.9 5	
5.0 2		10.5 9		10.6 46		11.6 29		2.6 2		2.7 2		4.0 6		10.4 2	
4.6 1	4.0 +	.0	4.0 +	13.1 6	19.0 12	23.4 15	17.9 4	11.3 2	9.3 +	12.5 1	4.7 1	6.9 6	16.8 11	16.9 10	7.0 1
M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M
6.1 2		39.3 32		11.1 6		20.7 46		6.6 2		15.9 10		2.7 +		6.4 2	
11.1 3		5.7 3		7.4 14		19.6 45		29.2 19		18.5 4		19.7 4		22.6 8	
18.0 14		14.6 6		13.6 6		32.4 46		32.0 8		11.4 3		7.9 4		11.9 5	
11.2 36	9.9 15	16.4 4	26.2 1	11.0 1	6.8 +	5.4 1	7.2 3	7.5 10	6.0 1	.0	4.0 +	4.1 2	6.3 1	7.7 +	8.5 5
15.9 6		24.6 15		14.3 24		14.2 15		19.1 20		20.1 16		6.0 1		19.1 3	
8.2 6		6.8 1		30.3 41		37.1 36		13.7 2		6.9 2		9.9 2		14.0 10	
16.5 47		10.6 3		2.0 +		9.6 26		7.5 8		14.0 6		2.6 2		8.2 7	
23.4 3		.0		19.9 6		.0		16.9 1		3.0 +		46.5 63		43.7 27	
7.2 1		5.7 1		11.5 15		15.2 41		10.0 16		6.4 2		7.5 15		9.9 4	
15.2 54		14.2 16		11.2 1		30.8 9		24.7 9		13.4 5		15.3 4		11.8 2	

1 FIRST OF SEVERAL / PREMIERE DE PLUSIEURS

ON INDIQUE UN VENT D'OUEST PAR LA LETTRE 'W'

+ LESS THAN 0.5 PERCENT BUT NOT ZERO / INFERIEURE A 0.5 POURCENT MAIS SUPERIEURE A ZERO

STATION	HOURS / HEURES	PREVAILING DIRECTION / MEAN SPEED — DIRECTION DOMINANTE / VITESSE MOYENNE km/h		MAXIMUM HOURLY WIND VENT MAXIMAL HORAIRE — SPEED VITESSE km/h	DIRECTION	DATE	PEAK SPEED VITESSE DE POINTE — SPEED VITESSE km/h	DIRECTION	DATE
BRITISH COLUMBIA COLOMBIE-BRITANNIQUE									
ENTRANCE ISLAND	744	NW	23.3	47	NW	31	M		
ESTEVAN POINT	739	SVL	22.3	67	SSE	09	109	SE	04
ETHELDA BAY	744	SE	11.7	42	SE	09	M		
FORT NELSON A	744	N	8.1	28	N	SSI	65	N	24
FORT ST JOHN A	744	N	11.0	69	N	24	76	N	24
GERMANSEN LANDING	744	W	4.6	21	NW	07	M		
HOPE A	734	E	12.4	48	W	11	68	WNW	12
HORSEFLY SCPS	648	SW	12.2	61	SE	09	M		
HUDSON HOPE SCHPA DAM	739	W	10.2	42	W	091	M		
KAMLOOPS A	744	SE	11.3	52	W	11	69	N	12
KITIMAT TOWNSITE		M	M	M			M		
LAWYER ISLAND	744	SE	17.2	45	SE	025	M		
LEONARD ISLAND	742	SE	16.3	48	SE	04	M		
LUCY ISLAND	744	SE	24.4	72	SE	090	M		
MACKENZIE A	744	S	7.7	69	S	09	41	NE	25
MCINNES ISLAND	744	E	12.3	46	SE	051	M		
MERRY ISLAND	744	NW	16.8	69	SE	04	M		
MICA DAM	737	N	9.3	51	N	291	M		
MULE CREEK	739	S	20.6	61	E	19	M		
NANAIMO DEPARTURE BAY	744	W	9.9	37	NW	191	M		
NOOTKA LIGHTSTATION	744	N	16.4	66	SE	04	M		

SPEED CLASSES (%) / CLASSES DE VITESSE (%) — km/h

CALM CALME	1-5	6-11	12-19	20-29	30-39	40-49	50-61	>61
+	10	17	21	27	20	5		
0	5	17	18	19	18	11	5	1
1	26	23	26	10	5	+		
40	18	29	9	3				
34	5	22	21	12	5	1	+	
0	00	26	3	+				
7	16	25	29	16	3	+		
5	20	27	17	14	4	3	+	
3	26	27	23	10	2	+		
23	9	26	21	16	4	1	+	
M	M	M	M	M	M	M	M	M
+	12	24	30	17	12	5		
1	16	26	26	16	10	3		
+	10	21	17	17	15	8	6	4
29	10	25	21	6				
1	20	40	21	12	5	1		
+	12	20	24	16	10	3	1	
1	29	43	23	4	+			
+	10	16	21	29	15	6	1	
0	25	26	23	7				
	9	26	24	17	10	1	1	

AVERAGE SPEED IN km/h / VITESSE MOYENNE EN km/h

PERCENTAGE FREQUENCY OF DIRECTION / FREQUENCE DE LA DIRECTION EN POURCENTAGE

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
14.0 +		5.0 +		21.7 13		19.8 26		9.7 6		13.8 2		19.5 20		27.2 35	
13.5 6	9.0 1	9.1 1	11.4 2	11.5 5	26.3 16	32.9 17	27.3 6	16.8 4	17.1 1	8.2 1	8.7 1	12.4 3	22.7 6	30.6 17	21.0 6
3.5 3		10.8 24		9.1 4		15.8 35		2.5 +		11.8 14		4.7 1		9.1 16	
10.0 17	7.3 6	7.1 3	5.4 1	4.8 2	8.8 1	9.4 3	5.0 2	6.2 6	6.8 3	8.0 1	7.5 2	8.0 +	11.8 1	9.4 2	12.2 10
17.7 21	7.3 2	8.1 1	7.0 +	7.4 3	10.8 10	11.7 6	8.6 4	9.2 4	11.8 2	16.8 5	19.3 10	15.8 4	8.7 +	8.3 1	16.2 4
3.3 3		8.9 3		8.3 12		8.8 20		3.0 3		9.7 12		9.7 22		8.3 10	
0	3.0 +	8.1 2	14.3 8	13.8 34	11.7 9	8.8 4	8.1 1	4.6 3	8.8 5	7.1 4	8.8 5	21.8 11	21.1 6	21.8 1	0
12.2 20		8.9 6		16.8 +		19.8 17		22.8 3		7.8 39		13.2 1		21.8 9	
4.2 2		8.1 14		8.7 9		11.8 9		8.8 1		13.4 17		11.2 30		11.7 15	
11.8 2	12.2 1	14.8 +	8.8 1	13.8 8	16.7 11	17.3 13	10.3 8	8.4 3	7.4 1	17.1 1	16.4 2	11.4 7	18.8 9	20.1 10	16.3 3
M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M	M M
10.0 4		18.8 5		7.4 4		21.5 60		8.2 3		10.8 6		7.8 9		14.3 9	
11.0 6		8.7 6		8.7 15		19.2 30		22.1 15		11.8 2		8.8 5		18.8 30	
19.4 12		11.8 2		10.3 2		32.8 47		24.3 10		9.4 2		12.5 10		17.2 15	
8.9 6	8.8 2	14.8 3	12.8 2	8.8 2	8.8 +	8.8 3	8.8 12	11.8 27	8.9 4	8.8 1	10.8 1	13.8 3	12.8 2	8.1 1	8.8 2
14.8 6		13.7 8		7.7 21		13.4 30		17.3 15		11.8 9		8.8 3		19.8 17	
7.7 13		3.2 1		28.7 33		34.2 18		13.5 3		9.1 2		10.8 4		13.7 36	
10.8 37		11.4 3		8.8 +		8.8 31		7.8 11		14.8 5		3.8 1		8.8 11	
10.2 5		28.8 +		30.5 44		18.1 7		13.7 15		38.3 +		34.7 19		30.2 10	
11.5 1		7.8 1		8.5 15		10.7 17		8.2 10		4.5 2		11.7 38		18.1 19	
17.1 80		11.7 8		8.0 1		22.2 8		18.5 15		11.8 8		18.8 8		8.4 2	

VITESSE MOYENNE EN km/h

FREQUENCE DE LA DIRECTION EN POURCENTAGE

1 FIRST OF SEVERAL / PREMIERE DE PLUSIEURS

ON RENCONTRE UN VENT D'OUEST PAR LA LETTRE "W"

+ LESS THAN 0.5 PERCENT BUT NOT ZERO / INFERIEURE A 0.5 POURCENT MAIS SUPERIEURE A ZERO

TABLE 3

MONTHLY WIND SUMMARY

1631/8E KITIMAT TOWNSITE 1064320

YMo	Prevailing Direction	Mean Speed (km/h)	Maximum Hourly Wind Speed (km/h)	Direction	Date	Calm	Speed Classes (km/h)—Frequency (%) 1–5	6–10	11–20	21–30	31–40	41–50	51–60	60+
77 01	M	M	M			M								
77 02	M	M	M			M								
77 03	M	M	M			M								
77 04	M	M	M			M								
77 05	M	M	M			M								
77 06	M	M	M			M								
77 07	S	12.2	28*	SW	12	1	17	19	56	7				
77 08	SW	10.8	31*	SW	21	1	21	32	38	7	+			
77 09	NE	8.9	24*	N	15	1	30	34	32	2				
77 10	SW	8.9	32*	SW	12	5	34	24	31	6	+			
77 11	NE*	14.3	39*	SW	01	+	21	18	34	22	5			
77 12	M	M	M			M								
Annual	M	M	M			M								

Mean Wind Speed (km/h) and Percentage Frequency

YMo	N	NE	E	SE	S	SW	W	NW	V	Precip
77 01	M	M	M	M	M	M	M	M	M	.0
77 02	M	M	M	M	M	M	M	M	M	.0
77 03	M	M	M	M	M	M	M	M	M	.0
77 04	M	M	M	M	M	M	M	M	M	.0
77 05	M	M	M	M	M	M	M	M	M	.0
77 06	2.7*	2.0*	8.0*	11.0*	11.2*	15.6*	12.5*	3.5*	.0*	30.3
	1	+	+	14	40	39	2	1	0	
77 07	6.5	7.7	5.9	13.7	13.2	13.1	8.3	5.0	.0	91.8
	4	8	1	11	41	33	3	+	0	
77 08	10.3	9.5	4.5	11.2	10.0	12.8	7.2	9.5	.0	99.1
	17	21	3	5	18	34	2	1	0	
77 09	9.0	8.2	3.9	9.4	7.7	11.6	3.0	5.7	.0	95.7
	22	27	3	4	18	24	+	1	0	
77 10	7.7	8.8	3.4	7.6	6.5	13.7	3.2	5.5	.0	98.9
	19	19	2	5	18	30	1	1	0	
77 11	11.3*	17.0*	2.7*	8.5*	8.8*	17.7*	2.7*	14.5*	.0*	89.9
	22	30	1	5	14	27	+	+	0	
77 12	M	M	M	M	M	M	M	M	M	.0
Annual	9.4*	11.0*	4.1*	10.8*	10.2*	13.8*	8.9*	7.2*	.8*	42.4
	16	19	2	6	22	30	1	1	0	

TABLE 3

MONTHLY WIND SUMMARY

1031/8E KITIMAT TOWNSITE 1064330

YMo	Prevailing Direction	Mean Speed (km/h)	Maximum Hourly Wind: Speed (km/h)	Direction	Date	Speed Classes (km/h)—Frequency (%): Calm	1–5	6–10	11–20	21–30	31–40	41–50	51–60	60+
78 01	NE	21.1	46	NE	07		8	11	31	23	26	2		
78 02	NE	14.0	46	NE	01	2	22	20	29	21	5	1		
78 03	NE	9.8	34*	N	02	2	29	32	27	7	2			
78 04	SW	11.2	28*	NE	13+ +	1	23	24	43	9				
78 05	SW	9.9	28	SW	08+ +	5	20	31	36	6				
78 06	S	12.8	35*	S	17		13	28	50	11	+			
78 07	SW	12.8	29*	SW	10	+	14	24	52	10				
78 08	SW	11.1	29*	SW	03+ +	1	22	30	36	11				
78 09	NE	9.1	35*	NE	28	1	31	34	29	5	+			
78 10	SE	10.2	32*	SE	30	+	28	28	36	6	+			
78 11	N	14.8	51*	N	19	+	18	22	36	14	6	3	+	
78 12	SE	14.7	42*	N	16	+	18	15	41	22	4	+		
Annual	NE	12.8	51*	N	11 – 19	1	20	26	36	12	4	+	+	

Mean Wind Speed (km/h) and Percentage Frequency

YMo	N	NE	E	SE	S	SW	W	NW	V	Data Pairs (%)
78 01	16.6	25.2	14.2	11.7	7.4	10.5	5.0	3.0	.0	98.3
	21	66	3	1	5	5	+	+	0	
78 02	12.2	17.4	4.3	5.1	6.3	10.0	2.4	3.8	.0	97.9
	24	58	2	3	6	5	1	1	0	
78 03	9.6	11.0	3.6	8.0	8.1	11.7	3.2	5.5	.0	94.0
	27	33	1	5	16	14	1	+	0	
78 04	13.0	10.6	3.5	10.2	9.3	13.0	2.5	4.6	.0	93.2
	14	24	3	7	23	28	+	1	0	
78 05	5.0	7.4	3.8	9.7	9.5	12.6	3.7	11.0	.0	93.8
	4	12	4	11	26	37	1	+	0	
78 06	11.3*	7.4*	4.5*	10.6*	14.6*	13.3*	5.7*	8.5*	.0*	89.6
	6	16	2	5	30	31	1	1	0	
78 07	7.6	6.9	4.5	14.4	12.2	14.9	3.0	.0	.0	96.2
	7	10	1	9	25	48	+	0	0	
78 08	7.6	10.0	4.9	13.5	9.4	13.4	2.6	4.4	.0	99.9
	9	14	1	18	23	34	1	1	0	
78 09	10.0	10.3	4.5	10.6	7.3	9.6	4.2	5.9	.0	99.0
	14	28	3	12	23	19	1	1	0	
78 10	6.9	5.2	3.3	12.8	4.3	4.6	3.2	8.4	.0	96.9
	16	7	1	63	3	6	1	3	0	
78 11	18.9	9.7	2.5	13.5	7.4	5.0	2.0	12.5	.0	96.3
	43	5	+	36	5	4	+	5	0	
78 12	17.5	8.6	5.3	14.9	3.4	5.5	9.6	18.2	.0	99.2
	32	6	1	46	2	5	1	6	0	
Annual	13.5	14.8	5.7	12.9	16.9	12.4	4.0	11.8	.0	96.5
	16	23	2	18	16	20	1	2	0	

HUDSON HOPE BCHPA DAM B.C. PERIOD 1963-80 PERIODE

Lat. 56°01'N Long. 122°12'W Elevation 678 m Altitude

	JAN JANV	FEB FEV	MAR MARS	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOUT	SEP SEPT	OCT OCT	NOV NOV	DEC DEC	YEAR ANNUEL	
PERCENTAGE FREQUENCY FRÉQUENCE EN %														
N	6.0	8.0	9.2	8.7	7.9	8.6	8.6	7.1	4.9	2.4	1.7	1.9	6.2	N
NE	13.1	16.7	20.6	18.1	14.9	15.3	12.1	10.7	8.6	5.2	9.0	8.7	12.7	NE
E	10.7	16.1	11.7	11.4	5.7	6.0	7.3	6.0	5.9	3.6	6.8	8.2	8.3	E
SE	11.3	11.7	10.0	7.0	5.7	5.0	5.3	6.7	7.9	6.7	8.6	11.5	8.1	SE
S	9.3	7.5	6.3	7.3	7.5	6.6	8.9	10.6	9.0	12.7	10.8	12.1	9.0	S
SW	16.7	14.1	17.0	21.1	27.8	26.0	22.6	25.0	23.4	32.6	24.3	19.1	22.5	SW
W	15.7	10.4	12.6	11.4	12.1	12.2	16.4	16.5	21.6	22.2	20.9	21.8	16.2	W
NW	15.1	13.2	10.2	10.8	13.9	16.1	13.5	12.2	12.1	7.9	12.5	14.5	12.7	NW
Calm	2.1	2.3	2.4	4.2	4.5	4.2	5.3	5.2	6.6	6.7	5.4	2.2	4.3	Calme
MEAN WIND SPEED IN KILOMETRES PER HOUR VITESSE MOYENNE DES VENTS EN KILOMÈTRES PAR HEURE														
N	7.6	7.1	6.2	6.4	6.5	6.3	6.3	7.1	6.2	6.3	9.2	10.0	7.1	N
NE	11.0	9.0	9.1	7.9	7.9	7.4	8.3	8.3	9.1	10.1	13.2	13.5	9.6	NE
E	10.3	9.6	9.7	7.6	6.8	7.7	8.7	9.0	7.5	7.9	12.1	13.6	9.2	E
SE	9.1	10.2	8.9	8.6	8.4	8.8	7.0	7.5	7.2	8.9	9.5	10.9	8.8	SE
S	11.3	13.0	10.1	9.3	10.7	14.0	11.1	8.6	9.7	12.3	8.8	10.4	10.8	S
SW	10.6	11.5	11.6	14.0	13.2	13.5	10.4	10.1	10.9	12.5	10.5	10.5	11.6	SW
W	7.3	7.7	8.9	10.2	9.8	9.7	8.1	7.4	7.9	10.3	8.6	9.0	8.7	W
NW	12.6	10.8	8.3	8.5	8.7	8.8	7.9	7.7	7.9	8.2	11.3	12.4	9.4	NW
All Directions														**Toutes directions**
	9.9	9.6	9.1	9.1	9.4	9.6	8.3	8.0	8.2	10.1	9.8	10.8	9.3	
Maximum Hourly Speed														**Vitesse horaire maximale**
	50	47	47	45	42	61	45	51	43	60	58	61	61	
	NE	SVL	SW	SW	SW	SW	SW	NW	NE	SW	SW	SW	SW	

Height of anemometer 10.0 m hauteur de l'anémomètre

STATION INFORMATION

Surrounding country is mountainous and heavily wooded. Nearest obstruction is a small grove of trees 90.0 m south.

DONNÉES RELATIVES À LA STATION

Les environs sont montagneux et fortement boisés. L'obstacle le plus proche est un petit bouquet d'arbres à 90,0 m au sud.

KITIMAT TOWNSITE B.C. PERIOD 1967-80 PERIODE

Lat. 54°03'N Long. 128°38'W Elevation 128 m Altitude

	JAN JANV	FEB FEV	MAR MARS	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOUT	SEP SEPT	OCT OCT	NOV NOV	DEC DEC	YEAR ANNUEL	
PERCENTAGE FREQUENCY FRÉQUENCE EN %														
N	50.7	43.3	30.1	16.5	11.9	8.1	7.8	13.4	20.3	23.7	35.3	41.2	25.2	N
NE	17.0	16.4	14.5	9.9	12.1	7.1	6.2	8.9	12.4	11.9	19.3	16.6	12.7	NE
E	1.7	1.7	3.1	3.7	3.5	2.4	2.6	2.1	3.0	3.3	1.8	1.8	2.6	E
SE	6.0	2.7	9.0	7.6	16.9	15.4	20.4	17.2	14.8	17.4	10.9	14.5	12.7	SE
S	15.8	23.4	32.3	49.4	39.5	51.7	44.5	42.6	33.1	28.8	21.0	14.6	33.1	S
SW	4.7	5.0	7.1	10.7	13.1	13.5	16.2	12.4	11.1	8.4	7.3	4.9	9.5	SW
W	0.2	0.7	0.7	0.9	0.6	0.6	0.9	0.8	1.4	1.0	0.6	0.6	0.7	W
NW	3.1	2.9	1.4	0.4	1.5	0.6	0.8	1.6	2.0	3.0	2.3	4.0	2.0	NW
Calm	0.8	3.9	1.8	0.9	0.9	0.6	0.6	1.0	1.9	2.5	1.5	1.8	1.5	Calme
MEAN WIND SPEED IN KILOMETRES PER HOUR VITESSE MOYENNE DES VENTS EN KILOMÈTRES PAR HEURE														
N	20.5	15.5	14.0	12.6	11.0	9.9	9.5	10.6	10.7	10.6	14.0	16.5	13.0	N
NE	23.1	16.2	9.6	8.8	7.7	7.5	7.0	8.4	8.1	7.0	12.3	17.0	11.1	NE
E	7.9	4.0	4.4	5.3	5.9	5.2	5.6	5.3	4.1	4.0	3.5	4.7	5.0	E
SE	12.6	8.8	11.3	9.2	12.1	13.4	13.3	12.8	10.5	11.1	11.1	14.5	11.7	SE
S	13.1	11.1	10.9	11.7	11.6	13.0	12.4	11.4	10.4	10.9	11.0	11.0	11.5	S
SW	17.7	12.3	11.7	13.0	12.1	12.1	12.2	11.8	10.0	11.0	13.5	12.6	12.5	SW
W	5.6	4.5	4.6	4.6	4.8	4.9	6.2	4.9	4.4	3.6	4.0	4.5	4.7	W
NW	21.2	15.5	17.5	5.5	13.8	7.7	7.7	8.9	11.0	12.5	15.2	20.7	13.1	NW
All Directions														**Toutes directions**
	18.8	13.4	11.4	11.1	10.9	12.0	11.6	11.0	9.7	9.9	12.2	14.9	12.2	
Maximum Hourly Speed														**Vitesse horaire maximale**
	55	55	42	34	37	35	35	31	35	42	56	55	56	
	N	NE	NW	N	NW	S	SW	SVL	SVL	N	N	NW	N	

Height of anemometer 9.1 m hauteur de l'anémomètre

STATION INFORMATION

The anemometer is mounted on a 2 m mast on top of a 6 m building. The surrounding country is thickly wooded and mountainous. The winds would tend to be funnelled north and south along the valley of the Kitimat River.

DONNÉES RELATIVES À LA STATION

L'anémomtre est installé sur un mât de 2 m de haut, lui-même fixé au sommet d'un bâtiment de 6 m de haut. La région environnante est fortement boisée et montagneuse. Les vents tendraient à être canalisés vers le nord et le sud par la vallée de la rivire Kitimat.

MEAN WIND SPEED (km/h) AND PREVAILING DIRECTION
DIRECTION DOMINANTE ET VITESSE MOYENNE (km/h) DU VENT

	JAN JAN	FEB FÉV	MAR MARS	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE
BRITISH COLUMBIA COLOMBIE-BRITANNIQUE														
ETHELDA BAY	15.9	14.6	12.9	12.6	10.6	9.7	8.6	8.4	10.1	13.0	14.5	15.9	12.2	4
	NE	SE	SE	SE	SE	NW	S	SE	SE	SE	NE	NE	SE	
FORT NELSON A	4.9	5.8	7.3	8.7	9.5	8.8	7.9	7.8	7.1	6.8	5.1	4.3	7.0	2
	N	N	N	N	N	NNW	S	S	S	S	S	SSW	N	
FORT ST JOHN A	16.1	16.9	15.9	17.0	17.0	16.1	14.8	14.9	15.8	16.7	16.9	16.4	16.4	2
	N	N	N	SW	SW	SW	SW	SW	SW	SW	N	N	SW	
GERMANSEN LANDING	4.2	5.2	6.1	6.4	7.1	7.2	6.8	5.5	4.7	4.9	4.3	3.8	5.5	4
	SE	W	W	W	W	W	W	W	W	W	W	W	W	
HOPE A	9.7	8.1	7.9	9.9	11.0	12.0	12.1	11.5	8.4	7.1	7.9	7.8	9.5	5
	NE	E	E	SW	SW	SW	SW	SW	SW	E	E	NE	SW	
HOPE A	14.8	11.6	10.5	11.6	12.0	12.7	12.8	11.4	10.1	9.8	11.5	14.3	11.9	6
	E	E	E	E	WNW	WNW	WNW	WNW	E	E	E	E	E	
HUDSON HOPE BCHPA DAM	9.9	9.6	9.1	9.1	9.4	9.6	8.3	8.0	8.2	10.1	9.8	10.6	9.3	5
	SW	NE	NE	SW	SW	SW	SW	SW	SW	SW	SW	W	SW	
KAMLOOPS A	11.8	11.5	13.4	13.2	12.3	11.8	10.5	10.0	10.2	12.1	13.1	13.9	12.0	5
	E	E	E	W	W	W	W	W	E	E	E	E	E	
KELOWNA A	5.9	4.8	6.0	6.8	6.3	7.0	5.8	5.4	4.8	4.3	4.4	4.8	5.5	6
	N	N	S	S	S	S	N	N	N	N	N	S	N	
KIMBERLEY A	8.5	9.0	10.0	12.1	11.0	11.1	10.5	9.9	9.3	10.4	9.4	8.6	10.0	5
	S	S	S	S	S	S	S	S	S	S	S	S	S	
KITIMAT TOWNSITE	18.8	13.4	11.4	11.1	10.9	12.0	11.6	11.0	9.7	9.9	12.2	14.9	12.2	6
	N	N	S	S	S	S	S	S	S	S	N	N	S	
KITIMAT 2	10.3	8.6	8.8	9.7	10.0	10.7	9.6	8.9	8.1	8.0	8.0	7.9	9.1	6
	NW	NW	NW	SW	SW	S	S	S	S	NW	NW	NW	NW	
LAWYER ISLAND	22.8	22.2	18.3	16.3	14.1	12.1	10.8	10.1	13.7	18.3	21.4	22.0	16.8	5
	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	
LENNARD ISLAND	16.2	18.2	18.1	17.1	15.4	14.8	13.3	11.9	12.3	15.0	17.8	18.8	15.7	6
	SE	SE	SE	SE	NW	NW	NW	NW	SE	SE	SE	SE	SE	
LUCY ISLAND	23.8	26.9	23.8	22.8	18.6	15.5	13.0	13.7	17.0	22.8	25.5	27.8	20.9	5
	SE	SE	SE	SE	SE	W	W	W	SE	SE	SE	SE	SE	
LYTTON	8.0	8.7	9.5	12.4	11.8	13.4	11.8	11.4	9.3	9.9	7.7	7.3	10.1	4
	N	S	S	S	S	S	S	S	S	S	S	N	S	
MACKENZIE A	8.5	9.3	7.8	7.7	9.0	8.7	8.1	7.2	7.4	9.1	7.5	7.9	8.2	6
	SE	SE	S	S	S	SE	SE	SE	SE	SE	S	SE	SE	
MCINNES ISLAND	22.3	22.1	18.8	18.1	14.1	12.9	11.8	12.3	15.3	20.8	22.8	22.8	17.8	4
	E	E	SE	NW	NW	NW	NW	NW	NW	SE	E	E	NW	
MERRY ISLAND	20.2	19.4	20.2	17.8	15.7	16.0	14.7	14.4	15.2	18.4	20.5	23.3	18.0	4
	E	E	E	NW	NW	SE	SE	SE	NW	E	E	E	E	
MICA DAM	11.8	11.8	10.4	9.9	11.5	11.4	10.8	10.5	10.5	11.5	11.5	11.1	11.0	6
	S	S	S	N	S	S	S	S	S	S	S	S	S	
MT KOBAU OBSERVATORY	18.8	18.8	17.9	17.7	16.9	16.1	15.0	14.8	15.3	16.8	17.8	18.4	16.8	5
	NW	S	NW	NW	NW	NW	NW	NW	NW	NW	SE	S	NW	
NANAIMO A	5.7	6.2	7.5	7.9	7.8	6.9	6.9	6.3	5.7	5.9	6.0	5.9	6.5	5
	W	W	W	W	W	W	W	W	W	W	W	W	W	
NANAIMO DEPARTURE BAY	8.4	9.0	10.7	9.5	10.1	9.8	9.4	9.3	8.5	8.1	8.7	9.5	9.3	6
	W	SE	W	W	W	E	E	E	W	W	W	SE	W	
OLD GLORY MOUNTAIN	34.8	34.2	30.5	25.8	22.0	19.4	17.4	M	21.3	28.2	32.5	36.4	M	6
	NW	NW	NNW	NW	NW	NNW	NW	M	NNW	NNW	NW	NNW	NW	
PENTICTON A	16.5	14.3	13.1	11.8	10.5	10.3	10.2	9.7	9.8	11.9	16.0	16.0	12.7	2
	S	S	S	N	N	N	N	N	N	S	S	S	S	
PINE ISLAND	21.1	21.5	19.8	17.4	14.7	12.8	11.8	11.8	12.7	16.3	21.5	22.0	16.9	6
	SE	SE	SE	SE	NW	NW	NW	NW	SE	SE	SE	SE	SE	
POINT ATKINSON	13.7	14.2	15.3	15.0	13.5	13.9	12.2	12.8	12.0	13.2	14.8	15.9	13.9	5
	E	E	E	E	E	E	E	E	E	E	E	E	E	
POINTER ISLAND	23.1	19.9	14.7	12.8	9.0	9.0	8.0	8.3	9.3	13.0	18.5	20.4	13.8	6
	NE	NE	NE	S	S	S	S	S	S	S	NE	NE	S	

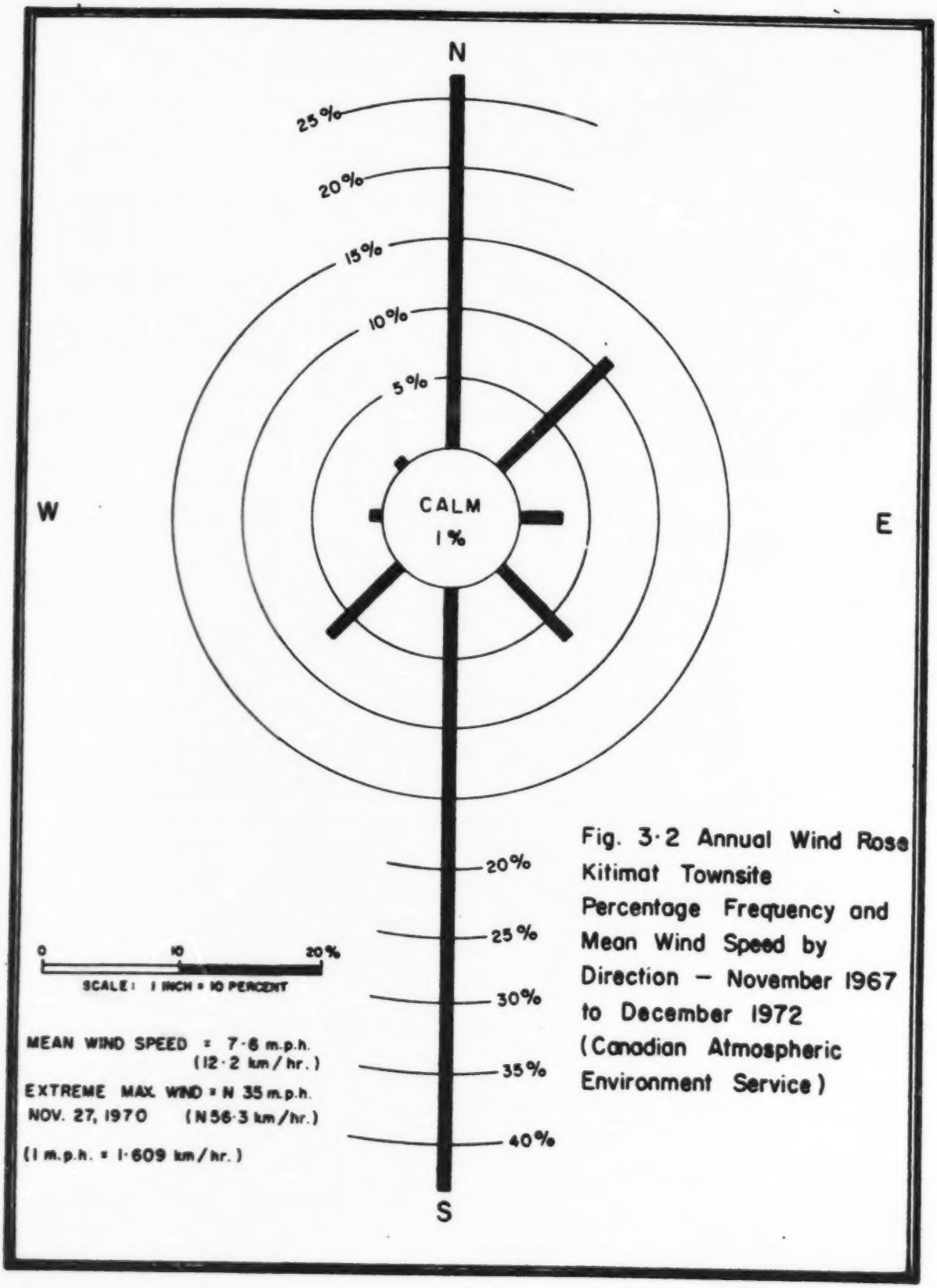
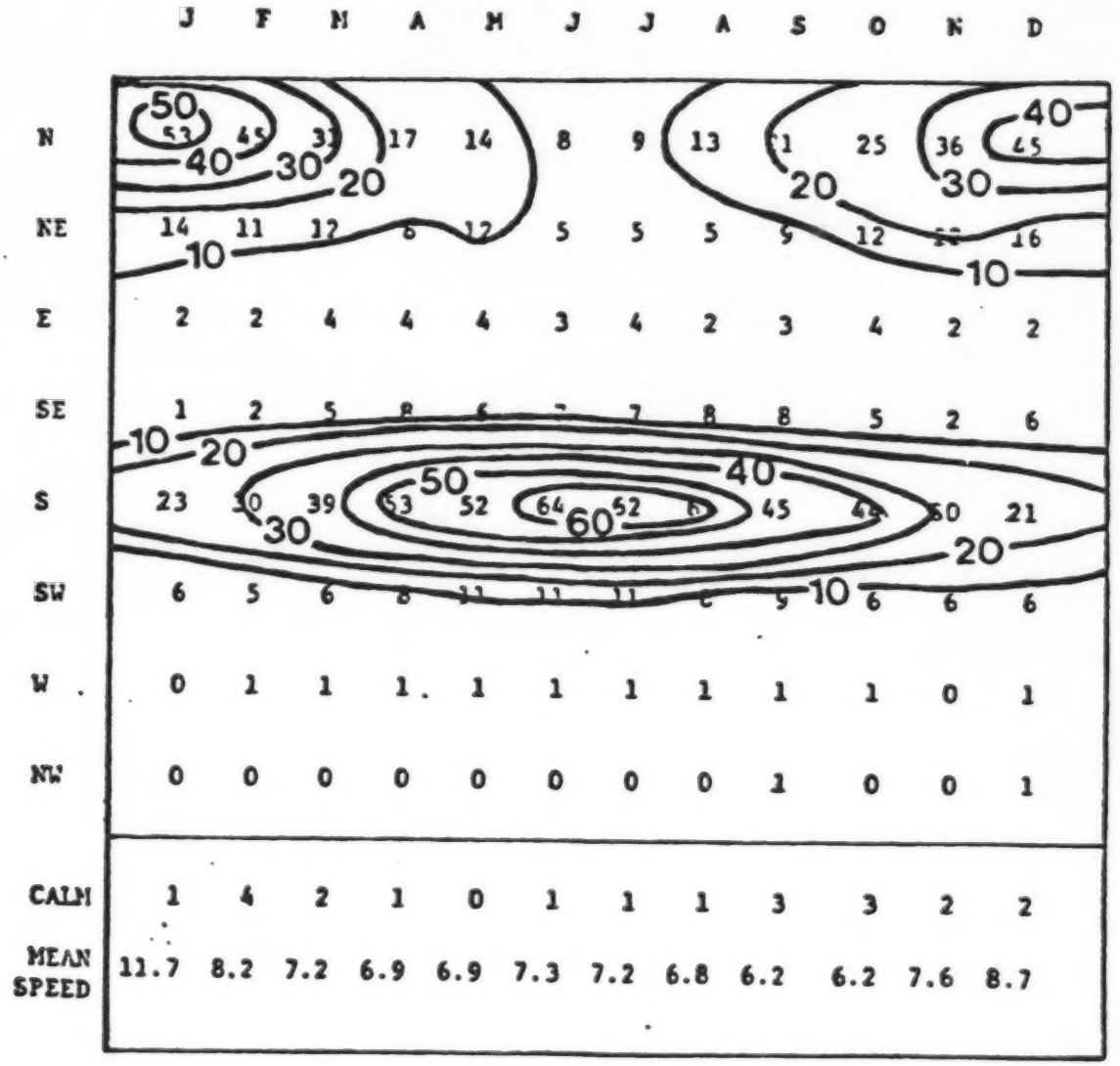


Fig. 3·2 Annual Wind Rose
Kitimat Townsite
Percentage Frequency and
Mean Wind Speed by
Direction – November 1967
to December 1972
(Canadian Atmospheric
Environment Service)

FIGURE 4

KITIMAT (TOWNSITE), B.C. - PERCENTAGE FREQUENCY WIND DIRECTION (AND CALMS) AND MEAN WIND SPEED BY MONTHS (NOVEMBER 1967 - AUGUST 1975)



	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
KITIMAT TOWNSITE															
54° 3'N 128° 39'W 128 m															
Daily Maximum Temperature	-1.8	2.4	6.0	10.6	15.4	18.6	20.9	20.6	16.7	9.9	3.7	0.4	10.3	2	Température Maximale Quotidienne
Daily Minimum Temperature	-7.2	-3.7	-1.9	0.9	4.3	8.4	10.9	11.1	8.0	4.0	-1.0	-4.2	2.5	2	Température Minimale Quotidienne
Daily Temperature	-4.5	-0.7	2.1	5.8	9.9	13.5	15.9	15.8	12.4	7.0	1.3	-1.9	6.4	2	Température Quotidienne
Standard Deviation, Daily Temperature	3.2	2.4	1.3	1.4	1.6	2.1	1.9	1.8	1.2	1.0	2.4	3.2	0.8	2	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	12.2	11.1	16.7	25.6	32.8	35.6	36.1	35.6	33.3	20.0	13.3	10.0	36.1		Température Maximale Extrême
Years of Record	24	26	26	24	25	27	26	27	27	27	26	24			Années de Relèves
Extreme Minimum Temperature	-25.0	-23.9	-19.4	-10.0	-6.7	-0.6	3.9	2.0	-2.0	-6.1	-16.3	-25.0	-25.0		Température Minimale Extrême
Years of Record	25	26	27	26	26	26	26	26	27	27	26	26			Années de Relèves
Rainfall	118.4	136.6	119.9	108.1	76.8	61.8	66.1	96.4	162.7	367.8	239.4	187.0	1753.0	2	Chutes de Pluie
Snowfall	188.4	100.1	56.2	10.4	0.0	0.0	0.0	0.0	0.0	4.8	58.0	129.4	548.3	2	Chutes de Neige
Total Precipitation	307.8	236.1	176.2	118.6	76.8	61.8	66.1	96.4	162.7	361.4	296.2	320.4	2298.8	2	Précipitations Totales
Standard Deviation, Total Precipitation	153.8	106.5	114.2	64.8	43.3	30.1	41.9	64.1	75.1	132.6	114.3	117.7	356.3	2	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	66.8	66.8	106.0	71.6	57.2	28.4	47.2	57.4	78.0	144.8	110.0	129.4	144.8		Chute de Pluie Record en 24 heures
Years of Record	24	25	26	25	24	25	26	25	26	24	24	24			Années de Relèves
Greatest Snowfall in 24 hours	106.9	112.3	56.4	28.2	T	0.0	0.0	0.0	0.0	33.0	76.7	57.2	112.3		Chute de Neige Record en 24 heures
Years of Record	24	26	27	26	26	27	27	26	26	26	27	26			Années de Relèves
Greatest Precipitation in 24 hours	106.9	112.3	106.0	71.6	57.2	28.4	47.2	57.4	78.0	144.8	110.0	129.4	144.8		Précipitation Record en 24 heures
Years of Record	24	25	26	25	24	25	26	25	26	24	24	24			Années de Relèves
Days with Rain	9	11	14	14	13	12	12	13	16	22	17	12	166	2	Jours de Pluie
Days with Snow	12	8	7	2	0	0	0	0	0	1	6	11	47	2	Jours de Neige
Days with Precipitation	18	17	17	14	13	12	12	13	16	22	20	21	195	2	Jours de Précipitation
KITIMAT 2															
54° 0'N 128° 42'W 17 m															
Daily Maximum Temperature	-1.4	2.6	6.8	10.7	15.2	18.5	21.2	20.8	16.7	10.3	4.2	0.8	10.6	8	Température Maximale Quotidienne
Daily Minimum Temperature	-6.3	-2.8	-0.6	2.0	5.0	9.0	11.5	11.6	8.6	4.9	-0.2	-3.6	3.3	8	Température Minimale Quotidienne
Daily Temperature	-3.8	-0.1	2.8	6.3	10.2	13.8	16.4	16.2	12.7	7.6	2.0	-1.4	6.9	8	Température Quotidienne
Standard Deviation, Daily Temperature	3.0	2.3	1.2	1.2	1.3	2.1	1.5	1.8	1.0	1.1	2.4	3.1	0.7	4	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	10.0	10.6	15.0	25.6	27.8	33.3	35.6	36.7	33.3	20.6	15.6	12.5	36.7		Température Maximale Extrême
Years of Record	14	15	15	15	15	14	14	14	15	15	15	15			Années de Relèves
Extreme Minimum Temperature	-23.3	-16.9	-14.5	-7.8	-2.2	3.3	2.8	2.8	0.0	-3.3	-15.0	-24.4	-24.4		Température Minimale Extrême
Years of Record	14	15	15	15	15	14	14	14	14	15	15	15			Années de Relèves
Rainfall	158.9	171.1	173.7	177.6	113.2	87.1	85.4	100.0	217.6	452.2	312.6	259.2	2308.6	8	Chutes de Pluie
Snowfall	102.8	67.5	34.1	3.2	0.3	0.0	0.0	0.0	0.0	0.4	38.9	74.4	321.6	8	Chutes de Neige
Total Precipitation	268.6	243.6	204.9	176.6	102.3	86.7	83.7	111.3	222.9	486.1	370.9	367.1	2791.9	8	Précipitations Totales
Standard Deviation, Total Precipitation	151.3	128.5	124.0	105.6	65.6	36.5	54.1	99.8	84.6	146.2	190.7	161.1	328.4	4	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	152.9	76.0	118.9	63.5	61.5	58.4	47.8	74.9	79.8	179.4	150.0	132.0	179.4		Chute de Pluie Record en 24 heures
Years of Record	14	15	15	14	15	14	15	14	15	15	15	14			Années de Relèves
Greatest Snowfall in 24 hours	62.6	76.2	53.6	20.3	0.0	0.0	0.0	0.0	0.0	1.8	43.2	42.9	62.6		Chute de Neige Record en 24 heures
Years of Record	14	15	15	15	15	14	15	14	15	15	15	14			Années de Relèves
Greatest Precipitation in 24 hours	152.9	100.3	118.9	63.5	61.5	58.4	47.8	74.9	79.8	179.4	150.0	132.0	179.4		Précipitation Record en 24 heures
Years of Record	14	15	15	14	15	14	15	14	15	15	15	14			Années de Relèves
Days with Rain	10	13	16	16	15	14	13	13	16	23	17	14	179	8	Jours de Pluie
Days with Snow	9	7	5	0	0	0	0	0	0	0	3	9	33	8	Jours de Neige
Days with Precipitation	17	17	17	15	15	14	13	13	16	24	20	19	200	8	Jours de Précipitation